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Instruction Book

Z-g DIAGRAPH
Type ZDU

BN 35610/50
BN 35610/60
BN 35610/75

ROHDE & SCHWARZ SALES CO., (USA), INC.
P. O. BOX 148 — 111 Lexington Ave.
Passaic, N. J. — PRescott 3-8010

Note: Always quote the Type and Order Number (BN) in addition to the Seriel Number (FNr.) of the set when asking for technical information and, in particular, when ordering repair parts.

Edition R 7608/162

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1. Specifications

1.1 Type ZDU Used as Impedance and Admittance Meter

Frequency range	30 to 420 Mc
Characteristic impedance Z_o	
model BN 35610/50	50 Ω
model BN 35610/60	60 Ω
model BN 35610/75	75 Ω
Measurement range for resistance and reactance	$Z_o/50$ to Z_o to 50 x Z_o
model BN 35610/50	1.0 to 50 to 2500 Ω
model BN 35610/60	1.2 to 60 to 3000 Ω
model BN 35610/75	1.5 to 75 to 3750 Ω
Indication	direct visual indication by light spot (a) resistive and reactive component on impedance-admittance chart, see pages 66 and 67 (b) magnitude and phase on impedance-admittance chart, see page 68 (c) complex reflection coefficient with respect to magnitude and phase on polar-coordinate chart, see page 69
Accuracy after amplitude and phase adjustment in the frequency range in which the adjustment has been made	diameter of the error circle about the light spot centre: 3% of the chart radius plus 3% of the galvanometer deflection. The total error is less than 2% in the vicinity of Z_o
Required generator voltage	less than 2 v open circuit
Voltage across test item	less than 20 mv
Connectors for test item and generator	R&S connector Dezifix B, adaptable to other types of connector, see page 16

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1.2 Type ZDU Used for the Determination of the Transmission Properties of 4- and Multi-terminal Networks

Frequency range	30 to 420 Mc
Types of measurement	(a) transfer constant (b) voltage ratio E_{out}/E_{in}
Measurement range	
attenuation	0 to 30 db
phase	0 to 360°
Accuracy	
attenuation	±5% ±0.2 db
phase	±1.5° at 0 db ±5° at 20 db
Indication	direct visual indication by light spot on polar-coordinate chart, Fig. 5, page 70
Load impedance of the network	Z_o ±1% cable errors are not included
Input impedance of the network	Z_o ±1% this impedance is composed of the characteristic impedance Z_o of the Type ZDU and of that of the feed unit; cable errors are not included
Connection between network and Type ZDU	two cables of equal electrical length (pair of measuring cables) and one 4-terminal feed unit, see page 10
Voltage across input of 4-terminal network	
in type of measurement (a)	less than 40 mv
in type of measurement (b)	approx. 20 mv
Connectors	same as under 1.1

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1.3 Type ZDU Used for Determination of the Phase Angle between two Voltages of Equal Frequency

Frequency range	30 to 420 Mc
Measurement range	0 to $\pm 180^{\circ}$
Accuracy	$\pm 1.5^{\circ}$
Indication	direct visual indication by light spot on polar-coordinate chart
Minimum voltage requirement for phase measurement	approx. 2 mv
Maximum permissible voltage	approx. 15 mv
Input impedance of coaxial test line and of coaxial reference line	Z_o $\pm 1\%$
Connectors	same as under 1.1

1.4 Type ZDU Used as a Tuned Linear Test Receiver

Frequency range	30 to 420 Mc
Input requirement for full-scale deflection on reference meter	approx. 20 mv
Threshold sensitivity	approx. 0.5 mv
Bandwidth	approx. 70 kc increased to approx. 500 kc by automatic frequency control
Input impedance and connectors	same as under 1.1

1.5 Other Data

Power supply	115/125/220/235 v ±10% 47 to 63 cps and 400 cps
Power consumption	approx. 180 va
Valves, etc.	2 valves EA 50 1 valve EC 81 14 valves EF 80 2 valves EF 800 1 valve EL 84 2 valves EZ 80 2 valves PL 81 1 reference tube 85 A 2 2 crystal diodes R&S Stock No. GK 1011 C 1 crystal diode R&S Stock No. GK 1111 7 crystal diodes R&S Stock No. GK 2521 1 incandescent lamp R&S Stock No. RL 303 1 projector lamp R&S Stock No. RL 301 1 miniature glow lamp R&S Stock No. RL 210 2 scale lamps R&S Stock No. RL 165 S 1 fuse 1.6 amps 1,6 D DIN 41571 (for 220/235 v) 1 fuse 0.25 amp 0,25 C DIN 41571
Dimensions	560 x 340 x 480 mm
Weight	approx. 55 kg

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2. Accessories (included in the price of model BN 35610/50 or BN 35610/60 or BN 35610/75)

1 patch cord, 2 metres in length, with female connectors and safety plug "Schukostecker" for connection of the Type ZDU to the AC supply . . . . R&S Stock No. LK 333

1 feed cable, 75 cm in length, with R&S connector Dezifix B for connection of the Type ZDU to the generator

for Type ZDU BN 35610/50 . . . . . BN 90555/75

for Type ZDU BN 35610/60 . . . . . BN 90556/75

for Type ZDU BN 35610/75 . . . . . BN 90557/75

2 Dezifix short-circuit connectors . . R&S Stock No. FZ 434

20 charts . . . . . BN 35611/1709 (Fig. 1, page 66)

20 charts . . . . . BN 35611/2692 (Fig. 2, page 67)

20 charts . . . . . BN 35611/1659 (Fig. 3, page 68)

20 charts . . . . . BN 35611/1657 (Fig. 4, page 69)

20 charts . . . . . BN 35611/1658 (Fig. 5, page 70)

1 chart case for storage of charts . . BN 3561 - 46

3. Recommended Accessories to increase the possibilities of measurement

3.1 Pair of 2-terminal Measuring Cables

For Type ZDU	With connector	Length	Order Number
BN 35610/50	Dezifix B	1 m	BN 35613/50/1
		2 m	BN 35613/50/2
		5 m	BN 35613/50/5
	Series N UG-21 D/U	1 m	BN 35613/50/1 N
		2 m	BN 35613/50/2 N
		5 m	BN 35613/50/5 N
BN 35610/60	Dezifix B	1 m	BN 35612/1
		2 m	BN 35612/2
		5 m	BN 35612/5
BN 35610/75	Dezifix B	1 m	BN 35613/80/1
		2 m	BN 35613/80/2
		5 m	BN 35613/80/5

The two cables of such a pair of 2-terminal measuring cables are of equal electrical length; they are used in measurements on test items which cannot be connected directly to the Type ZDU. Moreover, they are used in 4-terminal network measurements.

Difference in the electrical length between the two cables of a pair, on delivery . . . . . less than 0.002 x l + 2 mm

Tolerance of mechanical length of a pair of cables . . . . . -60 to +90 mm

Permissible strain

Bending radius . . . . . greater than 40 cm
greater than 60 cm for BN 35612/..

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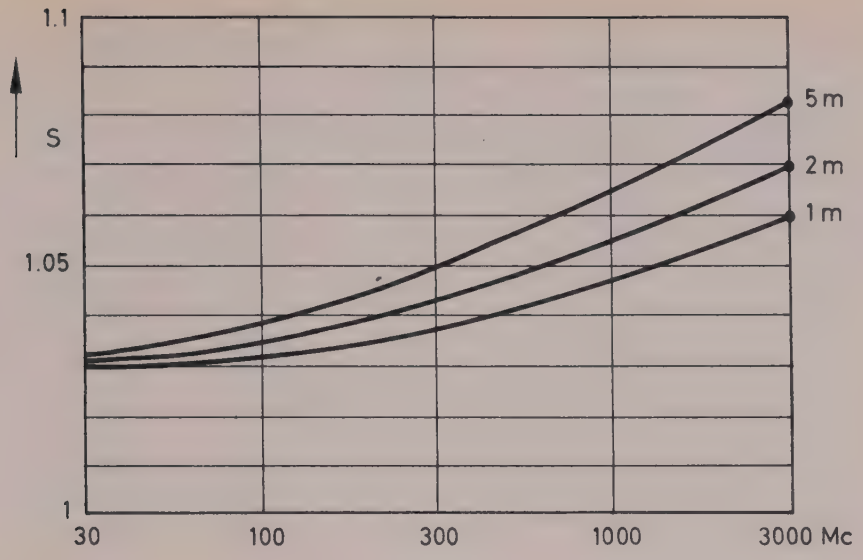
Tensile strength . . . . . less than 2 kg_f

Weight . . . . . 1 to 4 kg depending upon BN

VSWR . . . . . see curve on next page



VSWR of a single cable
1 m, 2 m, and 5 m in length

Instructions on how to maintain the high electrical quality of the cables are given in the "Technical Information R 7569".

3.2 4-terminal Feed Unit

for Type ZDU BN 35610/50 . . . . . BN 35615/550
for Type ZDU BN 35610/60 . . . . . BN 35614/660
for Type ZDU BN 35610/75 . . . . . BN 35615/880

A 4-terminal feed unit consists of a feed unit and the feed cable; connectors to order; it is used, for example, in 4-terminal network measurements; see Fig. 11, page 73.

3.3 UHF Attenuators Type DPF

Model	Z_o	Attenuation	Frequency range	VSWR
BN 18060/50	50 Ω	5 db	0 to 4000 Mc	< 1.08
BN 18060/60	60 Ω			
BN 18061/50	50 Ω	10 db		
BN 18061/60	60 Ω			
BN 18062/50	50 Ω	20 db		
BN 18062/60	60 Ω			

These attenuators have adaptable R&S connectors Dezifix B; power-handling capacity 0.5 w. For uses see Figs. 8 and 9, page 72.

3.4 Matching Pads Type DAF

Model	Impedance transformation	Attenuation	Frequency
BN 18083	60 Ω to 75 Ω	4 db	0 to 1000 Mc
	75 Ω to 60 Ω	6 db	
BN 18084	50 Ω to 75 Ω	4.2 db	
	75 Ω to 50 Ω	7.8 db	
BN 18085	50 Ω to 60 Ω	4.2 db	
	60 Ω to 50 Ω	5.8 db	

These matching pads have adaptable R&S connectors Dezifix B. They are indispensable in most cases where two instruments or cables differing in characteristic impedance must be matched. Here they act as impedance transformers. They are also usable as attenuators. If, for example, two pads BN 18083 are connected by their 75-Ω ends, one obtains an attenuator with Z = 60 Ω and an attenuation of 4 + 6 = 10 db. If the 60-Ω ends are connected together, one obtains Z = 75 Ω and again 4 + 6 = 10 db attenuation.

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3.5 Broadband Baluns Type BSU

Item	Model	Bal./Unbal.	Frequency range
a	BN 90610/50	50 Ω : 50 Ω	10 to 90 Mc
b	BN 90611/50		30 to 180 Mc
c	BN 90612/50		85 to 300 Mc
d	BN 90610/60	60 Ω : 60 Ω	10 to 90 Mc
e	BN 90611/60		30 to 180 Mc
f	BN 90612/60		85 to 300 Mc
g	BN 90610/D		10 to 90 Mc
h	BN 90611/D		30 to 180 Mc
i	BN 90612/D		85 to 300 Mc

All models have an adaptable R&S connector Dezifix B at the unbalanced side. At the balanced side, the models a to f are equipped with two knurled terminals, the models g to i with a shielded twin socket. These broadband baluns serve as transition units between a balanced and an unbalanced point, ensuring low SWR. For example, they serve to match a balanced aerial to the unbalanced input of the Type ZDU. Balanced items can thus be measured.

3.6 Impedance Transformers Type BSI

Model	Unbal./Bal.	Frequency range
BN 90634/200	50 Ω : 200 Ω	10 to 100 Mc
BN 90635/200		100 to 420 Mc
BN 90634/240	60 Ω : 240 Ω	10 to 100 Mc
BN 90635/240		100 to 420 Mc
BN 90634/300	75 Ω : 300 Ω	10 to 100 Mc
BN 90635/300		100 to 420 Mc

These transformers are equipped, at the unbalanced side, with an adaptable R&S connector Dezifix B and, at the balanced side, with two sockets of 12.6 mm spacing for 1.3 mm pin diameter. The mating two-contact plug BN E 435/4-30 has a pin diameter of 1.3 mm and a pin spacing of 12.6 mm for connection of a balanced twin lead. Also supplied is an adapter BN E 454/4-28 for connection of plugs with 3-mm pins, spaced 12 mm. All these models of Type BSI have a transformation ratio of 1:4. The impedance transformer on the one hand makes possible measurements on balanced items and on the other hand affords more accurate measurement of high impedance since, as seen from the Type ZDU, the Z value is four times reduced. When selecting a Type BSI, consider the unbalanced impedance value; for example, with a Type ZDU of Z_o = 60 Ω always use a Type BSI for $Z_{unbal.}/Z_{bal.}$ = 60/240 Ω, even if an impedance of, say, 300 Ω is to be measured.

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3.7 Adjustable Short . . . . . BN 39591/50, Z_o = 50 Ω
BN 39591/60, Z_o = 60 Ω
BN 39591/75, Z_o = 75 Ω

Generally speaking, the adjustable short serves to obtain accurately-known reactances. Because of its perfect homogeneity and its close tolerances it can be regarded as a reactance standard. The maximum usable length is 130 mm; the setting accuracy is ±0.05 mm with vernier and ±0.005 mm with the gauge blocks 2, 5, 10, 20, 30 and 40 mm. In conjunction with the Type ZDU the adjustable short can be used for compensation, for example when a test item must be connected via a short length of cable and the result must be referred to the test item at the cable end. The assumption is, of course, that the electrical length of this cable does not exceed the maximum electrical length of the adjustable short.

3.8 Transistor Adapter . . . . . BN 35616/50, Z_o = 50 Ω
BN 35616/60, Z_o = 60 Ω
with accessories for DC supply

The input impedance or admittance of transistors with three or more electrodes can be measured along with their transmission characteristics in both directions, the terminating loads being selectable. For details see the respective "Technical Information".

3.9 Screw-in Assemblies

Our instruments provided with R&S connectors Dezifix B can easily be adapted to other connector systems. At present the screw-in assemblies listed on the next page are available. For selection of the proper screw-in assembly it should be considered that R&S measuring instruments and accessories have, depending on their internal setup, either Dezifix B connectors with cable base or tube base. A cable base is the base part where the coaxial section continues within the instrument as a cable, as e.g. at the INPUT of the Type ZDU. In the case of a tube base, a tube with unchanging cross section continues within the instrument, as e.g. at the connectors **COAXIAL TEST LINE and COAXIAL REFERENCE LINE** of the Type ZDU and at the UHF Attenuator Type DPF. Moreover, care should be taken to ensure that the characteristic impedance of the screw-in assembly is the same as that of the given Dezifix connector.

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The adaptation is simple: Unscrew the outer conductor of the Dezifix connector with the adapting wrench, Order Number FZM 10900, and the inner conductor, using a screwdriver (4 mm). Then the inner or the outer conductor of the required screw-in assembly can be screwed in. It is recommended that the Dezifix connectors and screw-in assemblies be carefully stored, since even slight mechanical damage may deteriorate the electrical properties.

Desired connector on the instrument	Order Number of the screw-in assembly	
	for Dezifix B with cable base	for Dezifix B with tube base
50-Ω socket UHF series (MIL)	FHD 10910/50	FHD 10900/50
50-Ω plug UHF series (MIL)	FHS 10910/50	FHS 10900/50
50-Ω socket N series (MIL)	FHD 20910/50	FHD 20900/50
50-Ω plug N series (MIL)	FHS 20910/50	FHS 20900/50
75-Ω socket N series (MIL)	——	FHD 20900/75
75-Ω plug N series (MIL)	——	FHS 20900/75
50-Ω socket C series (MIL)	FHD 30910/50	FHD 30900/50
50-Ω plug C series (MIL)	FHS 30910/50	FHS 30900/50
50-Ω socket BNC series (MIL)	FHD 40910/50	FHD 40900/50
50-Ω plug BNC series (MIL)	FHS 40910/50	FHS 40900/50
50-Ω socket 4,1/9,5	FID 20910/50	FID 20900/50
50-Ω plug 4,1/9,5	FIS 20910/50	FIS 20900/50
50-Ω socket 7/16	FID 40910/50	FID 40900/50
50-Ω plug 7/16	FIS 40910/50	FIS 40900/50
60-Ω socket 3,5/9,5	FID 20910/60	FID 20900/60
60-Ω plug 3,5/9,5	FIS 20910/60	FIS 20900/60
60-Ω socket 6/16	FID 40910/60	FID 40900/60
60-Ω plug 6/16	FIS 40910/60	FIS 40900/60
50-Ω connector 874 Gen. Radio	FLA 20910/50	FLA 20900/50
50-Ω connector H 4 Marconi	FLB 20910/50	FLB 20900/50

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4. Uses

For the determination of impedance and transmission characteristics, the frequency range of the Z-g Diagraph Type ZDU represents a border region characterized by the transition from test methods using lumped elements to those using distributed elements. The Type ZDU employs a uniform technique maintaining the same high accuracy throughout the entire range.

The Z-g Diagraph applies the principle of the directional coupler, which is normally used in UHF and SHF engineering, but is just as well suited to the VHF and short-wave ranges. Dependent on the measuring problem, the measured values can directly be read on the Smith chart or on a special polar-coordinate chart without any arithmetical or graphical evaluation whatsoever. This fact is of particular importance when investigating test items within a broad frequency band, since such measurements take relatively much time when made with slotted lines. With the aid of the Z-g Diagraph, broadband diagrams of the impedance or admittance of apparatus such as antennae, transformers, absorbers, filters and other networks can be plotted within a few minutes, exchangeable charts permitting particularly simple and time-saving recording.

When examining hard-to-get-at items such as high antennae, it is always found to be annoying that the impedance measured at an input of a connecting cable must first be changed by the phase angle of this cable, if one wants to determine the true antenna input impedance, and that this phase shift varies with frequency. Thanks to a special design of the Z-g Diagraph, it is possible to indicate the true impedance of the test item on the screen by connecting a second cable, having the same electrical length as the test cable, to a test output provided on the set for this purpose. The phase shift thus being eliminated, there is no need for any conversion or graphic evaluation, provided the characteristic impedance of the cable employed is sufficiently uniform; errors with respect to Z will fully enter into the test result.

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In addition, the employed measuring method permits representation of transmission parameters of 4- and multi-terminal networks directly on a polar-coordinate chart assigned to the attenuation constant and the phase constant. By means of two RF cables of equal electrical length and the characteristic impedance Z_o, one measures the transfer constant for the condition source impedance Z_s = load impedance Z_o = impedance Z_o. When

using a suitable matching element, it is also possible to perform investigations in the case that Z_s and Z_1 are not equal to Z_o.

The Z-g Diagraph also provides for measurements of the impedance, the admittance and the transmission characteristics of transistors, in order to determine their RF 4-terminal parameters. In this case, however, the transistor to be measured requires a jig which up to the connection pin has a characteristic impedance approaching Z_o as closely as possible. The transistor adapter listed under 3.8 is available for these measurements.

Within the frequency range 30 to 420 Mc the phase angle between two voltages of equal frequency can be directly read between $+180^\circ$ and -180° from a polar-coordinate diagram. In this case, the voltages to be compared need not be of the same value, the only condition being that they lie within the specified voltage range.

Between about 0.5 and 20 mv, the built-in superheterodyne receiver may also be used as a linear test receiver. This may be of interest in spite of the fact that the sensitivity is reduced by the directional couplers, since the input impedance of the receiver is Z_o within 1% over the entire frequency range. Finally attention is called to the fact that the measuring heads proper do not include moving parts. This is of particular importance for reproducibility of the results and for the operating stability of the equipment.

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5. Operating Instructions

5.1 Adapting the Set to the Local AC Supply Voltage and Frequency

The Z-g Diagraph is factory-adjusted for operation from 220 v and 47 to 63 cps. For a voltage other than 220 v, the set must be adapted correspondingly. To this end, it is necessary to loosen the four cylinder-head bolts at the corners of the front panel; it is then possible to remove the set from its cabinet. With the power cut off, the fuse must be inserted in the clips, identified by the required voltage rating. The fuse provided for an AC supply voltage of 220 v or 235 v is rated for 1.6 amps (1,6 D DIN 41571) and is to be replaced by a 2.5-amp fuse (2,5 D DIN 41571) in the case of a 115-v or 125-v AC supply. The set is connected to the AC supply through the power cable supplied (see accessories).

For an AC supply frequency of 400 cps, the AC supply frequency selector located near the AC supply tapping panel must be adjusted correspondingly. For this purpose it is necessary to loosen the two screws, to change over the link, so that the connection between the two screws is interrupted, and then to tighten the screws again.

5.2 Preparation for Use

Place the set on a nearly horizontal base, take the coaxial test line from the lid of the set, insert it into the hole in the right wall of the cabinet and secure it by turning against the stop. Throw INDICATION switch (which is also the power switch) to NORMAL; the set is then switched on. The signal generator used for the measurement should be capable of delivering 2 v open circuit at a source impedance of 50 Ω to 75 Ω, so as to fully drive the Z-g Diagraph at every frequency. The maximum permissible RF input voltage is 5 v. In conjunction with the Type ZDU it is advisable to use our Power Signal Generator Type SMLM (30 to 300 Mc) or the Type SDR (300 to 1000 Mc), or Type SLRD (275 to 2750 Mc). Connect the signal generator to the INPUT socket on the front panel. Allow a warm-up period of 15 minutes before measuring.

5.3 Handling the Chart Holder

For inserting the chart, remove the bezel and put the chart, fitted with two guide holes, on the plexiglass screen. Replace the bezel, thus pressing the chart against the plexiglass screen. The impedance-admittance charts (Figs. 1 to 3) can be inserted in such a way that either 0 or ∞ (with the chart of Fig. 2 either 0.5 or 2, due to the extended scale) is above the black line of the plexiglass screen. In the first case, the results represented on the chart are impedances, in the second case, they are admittances. Insert the charts shown in Figs. 4 and 5 always so that with the first 180° and with the latter 0° is above the black line.

5.4 Adjustments

5.4.1 Zero Setting of the Light-spot Galvanometer

With zero voltage applied to the light-spot galvanometer (reduce amplitude of the signal generator to 0 or disconnect the patch cord from the signal generator or switch to another range), set the crosslines of the light spot of the galvanometer precisely to the centre of the chart (mechanical zero) using a screw driver. In the impedance-admittance chart the centre of the chart is the point $Z/Z_o = 1$. The two slotted screws for the VERTICAL and HORIZONTAL adjustments are on the front panel below the chart screen.

5.4.2 Amplitude and Phase Adjustment for 2-terminal Network Measurement

Before starting the measurement, adjust the instrument with respect to amplitude and phase. If impedances, admittances or reflection coefficients are to be measured, short the coaxial reference line and the coaxial test line using the two short-circuit Dezifix connectors FZ 434 supplied with the set. If, however, the complex voltage ratio or the transfer constant is to be measured, proceed as described in section 5.5.6.2.

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To maintain the accuracy specified in 1.1, make the amplitude and phase adjustment each time the frequency range is changed. For a long series of measurements check the two adjustments several times, especially during the first hour after the set has been switched on. Make the checks at that

frequency which is later to be used as test frequency or at the medium frequency of the range in which it lies.

5.4.2.1 Amplitude Adjustment

After tuning the oscillator to the signal-generator frequency (section 5.5.1), adjust the amplitude of the signal-generator frequency until the centre of the crosslines of the light spot comes to a standstill at the outermost circle of the chart. If this output of the signal generator is reached, the reference meter should deflect to 100 (red line). If this is not the case, adjust the knob marked REFERENCE VOLTAGE COR. for a deflection to this value. If the signal generator has changed its frequency while the amplitude was adjusted, retune the signal generator and repeat the amplitude adjustment.

5.4.2.2 Phase Adjustment

Small phase variations caused by aging or by the slight temperature response of the IF amplifier result in an error of the phase angle of the reflection coefficient. These variations can be compensated for with the knob PHASE COR. For this purpose, insert a chart, preferably the one used later on for the measurement. With the aid of the knob PHASE ADJ., turn the chart until the crosslines of the light spot, which after adjustment according to section 5.4.2.1 is on the greatest chart circle, appear at $Z_o = 0$ (impedance measurement) or ∞ (admittance measurement) or at 0° or 180°, depending on the chart used. The chart holder should be in such a position that the black line of the plexiglass screen is at that side to which the light spot deflects. After having pressed the button+) below the small meter, turn the knob PHASE COR. so that the smaller meter shows maximum deflection. To check this adjustment, find the maximum once again by rotating the chart. The Z-g Diagraph is ready for measuring if, at maximum deflection of the meter, the crosslines appear at the same place as before. After a change in frequency the phase adjustment should be repeated.

+) If this button is pressed, it remains down until it is released again by being pressed anew.

5.5 Measuring

5.5.1 Frequency Adjustment

After the desired measuring frequency has been adjusted on the signal generator, throw the FREQUENCY RANGE switch of the Type ZDU to the corresponding range. Now tune the built-in oscillator by means of the coarse-fine drive marked FREQUENCY so that the pointer of the left-hand meter deflects to the red range. Do not press the button. Unambiguous tuning is ensured since the incorporated automatic frequency control will always shift the oscillator away from the resonance point if one adjusts to the image frequency. To find the correct adjustment easily, turn the tuning knob counterclockwise; the first resonance encountered is the correct one. The fine adjustment of the frequency is made using the larger knob.

5.5.2 Impedance Measurement

Insert the chart shown in Fig. 1 or Fig. 3 as an impedance chart, i.e., $\underline{Z}/Z_o = 0$ should be above the black line of the plexiglass screen. Connect the test item to the coaxial test line while the coaxial reference line remains short-circuited by FZ 434. After adjustment for the desired measuring frequency, increase the input voltage until the pointer of the right-hand meter deflects to 100 (red line). Once again check on the left-hand meter that its pointer still is in the red range; if this is no longer the case retune the signal generator for the proper frequency. Press the button and turn the PHASE ADJ. knob until the pointer of the meter is at maximum. Read the result on the chart or mark the point of intersection of the crosslines with a pencil.

If, in the entire frequency range of interest, the crosslines of the light spot do not leave a circle around the centre with the values $\underline{Z}/Z_o = 0.5$ or $\underline{Z}/Z_o = 2$, insert the spread chart (Fig. 2) and switch to INDICATION SPREAD. This means x-3 magnification of the chart. The right-hand meter should be at full deflection (red mark) also for measurements in the spread range.

5.5.3 Admittance Measurement

Admittances are measured in the same way as impedances (section 5.5.2). The charts of Figs. 1 and 3, however, are inserted like admittance charts, i.e., so that $\underline{Z}/Z_o = \infty$ is above the black line. When using the spread range and the associated chart according to Fig. 2, insert this chart so that $\underline{Z}/Z_o = 2$ is above the black line.

5.5.4 Investigating the Impedance or Admittance of Hard-to-get-at Items

Connect the test item to the coaxial test line using a coaxial cable of impedance Z_o. Replace the short-circuit connector by a second cable of identical electrical length connected to the coaxial reference line. Insert the short-circuit Dezifix into the free end of this cable. Fig. 6 shows an example of such a test assembly.

To check whether the electrical lengths of the two cables are actually equal, short-circuit also the coaxial test line at its end, select the input voltage so high that the pointer of the right-hand meter deflects up to the red mark, press the button (below the left-hand meter) and turn the chart until the right-hand meter shows maximum deflection. The crosslines of the light spot should then again be on $\underline{Z}/Z_o = 0$ or $\underline{Z}/Z_o = \infty$, depending upon whether the chart has been inserted for impedance or admittance measurement. If the phase adjustment described in 5.4.2.2 was carried out before this measurement, it immediately shows the difference in the electrical lengths of the cables.

After the check has been completed, remove the short-circuit Dezifix connector from the measuring cable and connect the test item. Conduct the measurement as set forth under 5.5.2 or 5.5.3. The measured values read from the chart do not refer any longer to the junction plane between the Dezifix connector at the coaxial test line and the test item, but to the junction plane between the test item and the Dezifix connector at the end of the cable.

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As mentioned before, it is important for the accuracy of the measurement that the electrical lengths of the cables are equal and that their characteristic impedances are equal to the characteristic impedance of the Z-g Diagraph. Suitable cables, i.e. pairs of 2-terminal measuring cables (see sections 3.1 to 3.3), may be ordered from ROHDE & SCHWARZ.

5.5.5 Determination of the Complex Reflection Coefficient

Measure the complex reflection coefficient $\underline{p}_x$, defined by the equation

$$\underline{p}_x = \frac{\underline{Z}_x - Z_o}{\underline{Z}_x + Z_o},$$

with the coaxial test line terminated by a test item of the input impedance $\underline{Z}_x$, and proceed as in the impedance or admittance measurement set forth under 5.5.2 or 5.5.3. However, instead of the impedance chart, insert a chart bearing the inscription "Complex Reflection Coefficient Chart" (Fig. 4) in such a way that the angle of 180° is over the black line of the plexiglass screen.

5.5.6 Determination of Transmission Characteristics

5.5.6.1 Connection and Feeding of the 4-terminal Network

For the examination of the transmission characteristics of 4-terminal networks, cables or multi-terminal networks, connect the test item as shown in Fig. 7. For this purpose, a pair of 2-terminal measuring cables (see 3.1 to 3.3) and a 4-terminal feed unit (see 3.4), having the same characteristic impedance as the Type ZDU, are necessary.

For precision measurements, especially in the range of high frequencies, the defects of the cables, which are small but cannot be entirely avoided, and possible mismatch of the 4-terminal network to the cable cause additional reflections which influence the result of the measurement. However, you can largely avoid these effects by inserting an attenuator pad between feed unit and 4-terminal network input. If the 4-terminal network is matched relatively well to the cable, connect the attenuator pad as shown in Fig. 8.

If the 4-terminal network is poorly matched to the cable, it is more advantageous to connect the attenuator pad directly before the 4-terminal network, as shown in Fig. 9. If an attenuator pad is connected into the test-signal path, another should be connected ahead of the reference line, for symmetry. In any case, the latter should be connected directly to the feed unit.

5.5.6.2 Adjustment of Amplitude and Phase for 4-terminal Network Measurement

Before starting the measurement, it is necessary to make an adjustment of amplitude and phase (sections 5.4.2.1 and 5.4.2.2). The test assembly for the adjustment can be seen from Figs. 7, 8 or 9, but the 4-terminal network must be removed and the free cable end of B (Figs. 7 and 8) or the Attenuator Type DPF (Fig. 9) connected directly to the measuring input.

5.5.6.3 Measurement of the Complex Voltage Ratio $E_{out} : E_{in}$

For this purpose, use the "Transfer Constant Chart" (Fig. 5) and insert it in such a way that 0° is above the black line of the plexiglass screen.

The circuit arrangement to be used is shown in Fig. 7, the one for precision measurements with interconnection of attenuator pads is shown in Figs. 8 and 9. For this measurement, a simple T-section can be used instead of the feed unit, since it is of no importance whether the measurement is made with or without a series resistor (1 kΩ). The series resistor in the feed unit should be regarded as internal impedance of the generator, Since, however, during the measurement described below, the generator voltage is always so readjusted that the right-hand meter gives the same deflection, i.e., that the voltage at the T-section is kept constant, R_i is practically 0, no matter whether a resistor is present or not. Readjust the frequency according to section 5.5.1.

After the amplitude and phase adjustment, a is 0 and b is 0, where a is the attenuation and b the phase. Connect the test item to the test assembly as shown in Figs. 7, 8 or 9 and adjust the voltage at the generator so that the right-hand meter indicates 100. Press the button below the left-hand meter and turn the PHASE ADJ. knob so that the right-hand meter again deflects to 100. The light spot then shows on the chart the complex voltage ratio between the T-section point and the 4-terminal network output in degrees of angle and units of attenuation (db). The test item may always remain in circuit when another test frequency is adjusted for. After tuning of the oscillator, it is only necessary to reset the reference-voltage amplitude to 100 and, using the knob PHASE ADJ., to bring the pointer of the left-hand meter again to maximum.

If the frequency range had to be changed to adjust for another test frequency, a new amplitude and phase adjustment is necessary to maintain the accuracy specified in section 1.1

5.5.6.4 Measurement of the Transfer Constant for $Z_s = Z_1 = Z_o$

For measuring the transfer constant, use the "Transfer Constant Chart" and insert it in the chart holder as described in section 5.5.6.3. The transfer constant is defined by the equation

$$g_B = \ln \frac{E_o/2}{E_2},$$

provided that the source impedances and the load impedances are equal. However, the equivalent circuit arrangement (Fig. 10), which is the basis for this equation, is not realizable due to the parallel current paths and impedances. For this reason, a constant current is applied, which is realized by the relatively high impedance (1 kΩ) of the feed unit. Consequently, for measurements of the transfer constant, it is always necessary to use the feed unit. Without a test item, i.e., during the amplitude and phase adjustment preceding the measurement, the voltage applied to each of the two inputs (coaxial test line and coaxial reference line) is $\frac{E_o}{2}$, where E_o is the voltage indicated at the right-hand meter when the test item is removed.

If the test item is connected according to Figs. 7, 8 or 9 and if the reference voltage is not readjusted, the logarithmic ratio of the voltage applied to the coaxial test line to the voltage applied to the coaxial reference line corresponds, with respect to magnitude and phase, to the transfer constant

$$g_B = a_B + jb_B,$$

which, after the transformation

$$a = 20 \times \log \frac{1}{r}, \quad b = \varphi$$

may be represented in the "Transfer Constant Chart", which has been derived from the reflection-coefficient chart. In the case of a mismatched 4-terminal network, this result includes the transformation by the electrical length from the T-section to the 4-terminal network input.

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With this kind of measurement, the amplitude and phase adjustment has to be made again after every frequency change, in order to meet the defining equation of the transfer constant.

5.5.6.5 Measurement of the Transfer Constant for $Z_s \gtrless Z_1 \gtrless Z_o$

For the measurement of 4-terminal networks whose source impedance (Z_s) or load impedance (Z_1) differs from Z_o, matching pads must be used, e.g., our Type DAF. Fig. 11 shows the corresponding measurement circuit. For the rest, the measurement procedure does not differ from section 5.5.6.4.

5.5.7 Measuring the Phase Angle of Two Voltages of Identical Frequencies

When making investigations on directional antennae (straight groups, circular groups, etc.) and compensators, it is often necessary to determine the phase angle between two voltages of identical frequencies. After the amplitude and phase have been adjusted, apply one of the two voltages to be compared to the coaxial test line and the other to the coaxial reference line. Press the button below the left-hand meter and, by turning the PHASE ADJ. knob, bring the pointer of the left-hand meter to maximum deflection. The result is then shown on the "Transfer Constant Chart". In the case of an angle between 0 and 180°, the voltage applied to the coaxial test line is retarded by the measured angle in relation to the voltage present at the coaxial reference line. With angles between 180° and 360°, the conditions are reversed. The specified measurement accuracy holds under the assumption that the voltages applied deflect the spot galvanometer and the reference meter by at least 50%. If the voltages are too high, insert attenuator pads in both leads. The generator input at the front panel of Type ZDU remains open.

5.5.8 Using the Spot Galvanometer Section as a Linear Test Receiver

The input requirement of the coaxial test line is about 20 mv for full-scale deflection. The indication can be made either on a linear scale (reflection coefficient chart) or on a logarithmic scale (transfer constant chart), depending upon which of the two charts is used.

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5.5.9 Measurements on Transistors

A transistor can be treated as a 4-terminal network. For this reason, it can be tested with the Z-g Diagraph like a 4-terminal network, i.e., the input and output impedances or admittances and the transmission character-

istics can be measured like any 4-terminal network, thus permitting the determination of the 4-terminal network parameters in the high frequency range in question.

Due to the small size of the transistors, their connection to the Z-g Diagraph causes some difficulties, since the section of line between the coaxial test line and the transistor connection should have a characteristic impedance of Z_o, if possible, up to the pin. To this end, an adapter has been developed which meets these requirements and which, moreover, finds many other applications (see 3.8). This adapter serves for measuring the input impedances or admittances of transistors or their 4-terminal network transmission characteristics. The often necessary impedance and admittance measurements, during which the output electrodes of the 4-terminal network are short-circuited or open for RF signals, can be made in a simple manner. Finally, this adapter also permits, for example, diodes, chokes and resistors to be tested.

The coaxial DC feed section with capacitive DC separation, which is supplied as an accessory unit to the transistor adapter and is necessary for the measurement on transistors, can also be used without the adapter, if the test items must be fed with direct current. For details see the instruction book regarding the transistor adapter.

5.5.10 Measurement with Decreased Voltage

If, for example, for measuring the input impedance of a receiver, too high an AC voltage is applied, the measurement result will be incorrect due to overdriving. In the same manner, erroneous results may occur if the transistor is driven into the saturation region. To avoid this error, reduce the voltage applied to the unknown to one third. Proceed as follows:

Short the coaxial test line and the coaxial reference line, reduce the generator voltage and insert a "normal" impedance-admittance chart (Fig. 1) into the chart holder. Switch to INDICATION SPREAD. This makes the galvanometer three times as sensitive as before. Adjust the generator voltage so that the crosslines of the light spot are on the outermost chart circle. Due to the higher galvanometer sensitivity, this is the case with one third of the generator voltage required for INDICATION NORMAL. The right-hand meter, therefore, gives one third of its full-scale deflection. In the following measurements, always adjust for this

voltage. To facilitate the adjustment and to increase the accuracy, adjust for an even value of this voltage, using the knob REFERENCE VOLTAGE COR.

6. Description

There is a directional coupler in a coaxial test line and another in a coaxial reference line. The one mounted in the coaxial test line furnishes a voltage proportional to the reflection coefficient $\underline{p}_x$ of the test item, while the one mounted in the coaxial reference line supplies a reference voltage proportional to unity reflection coefficient. The reflection coefficient is obtained from the comparison of the two voltages. The phase angle between these two voltages equals the phase angle of the reflection coefficient of the test item plus a constant angle which depends on the termination of the reference line.

The two quantities p_x and φ_x of the complex reflection coefficient $\underline{p}_x$ are represented linearly on the Smith chart used for direct visual indication. p_x is a vector whose length, for $\underline{Z}/Z_o = 1$, equals zero and, for any reactances, is equal to the radius of the diagram. φ_x is the angle of this vector in relation to the real axis between $R/Z_o = 1$ and $R/Z_o = \infty$ and, for $\underline{Z}/Z_o = 0$, reaches the value $\pm 180^o$. In order to determine this phase angle, the two directional-coupler voltages are first converted to a constant intermediate frequency and impressed on both ends of an artificial line after amplification and limitation. If the amplitudes of these two IF voltages are of equal level, distinct minima are created on this line, the distance of these minima from the ends of the line being a linear function of φ_x. In order to co-ordinate the linear characteristic of the phase angle on the chart and on the artificial line, the latter has been wound round the chart and the chart has been made rotatable about $\underline{Z}/Z_o = 1$ and mechanically coupled with the probe of the artificial line. For indication of the magnitude of the reflection coefficient p_x, use has been made of a sturdy mirror galvanometer which furnishes a light spot travelling along a constant base between $\underline{Z}/Z_o = 1$ and the reactance circle. After the probe minimum has been found, the position of this light spot immediately yields $\underline{Z}/Z_o$ if the reference voltage is set to a red mark, i.e., its rated value.

A special automatic frequency control makes the local oscillator follow any variations of the signal-generator frequency so that errors for this reason are largely eliminated.

In order to enable measurements on radiating test items to be made, the coaxial test line has been provided at the side of the cabinet so that shieldings that are possibly set up do not bother the operator when measuring.

The theory of the Z-g Diagraph is treated in detail in Rohde & Schwarz-Mitteilungen, 1952, No. 2.

7. Periodical Inspection of the Set

Should be carried out every 500 operating hours.

7.1 Checking the Anode and Filament Voltages (see circuit diagram)

(a) The anode-supply voltage across contact 9 of the multi-point connector C (Fig. 13) should be 220 v ±5% to chassis. Deviations from this value can be compensated for by resistor R172. For AC supply fluctuations of ±12% referred to rating, the anode-supply voltage fluctuation ΔE should be less than ±1 v. See also section 8.4.

(b) The filament voltage is measured across contact 3 of the multi-point connector C (Fig. 13). It should be 6.5 v ±3% to chassis. Deviations can be compensated for by resistor R156. For AC supply fluctuations of ±12% referred to rating, the filament-voltage fluctuation ΔE should be less than 30 mv. If the specified values are not obtainable, refer to section 8.5.

7.2 Relative Frequency Response of the Test Receiver versus Reference Receiver

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Adjust amplitude and phase at a medium frequency. The coaxial test line as well as the coaxial reference line remains shorted. Measure the voltage in each frequency range at several frequencies. Adjust the generator voltage each time so that the pointer of the right-hand meter points at the red mark (full deflection). The phase and amplitude deviations of each range, which are observed by means of the crosslines of the light spot,

should not exceed a total of 3° and 0.5 db in every range where the adjustment has been made.

7.3 Checking the Quiescent DC Anode Current of R86

If valve R85 (Fig. 14) is removed from its socket, the pointer of the left-hand meter should exactly point to the centre of the red section. Correct for deviations using the variable resistor R37 (Fig. 13). If the adjustment range of R37 is not sufficient, replace valve R86 (Fig. 15).

7.4 Sensitivity of the Phase Indication with Respect to Frequency Detuning within the Red Section RESONANCE

Tune the Z-g Diagraph to the generator frequency, change this frequency so that the pointer of the left-hand meter deflects to the left end of the red mark. Adjust the phase with the coaxial test line and the coaxial reference line short-circuited. Adjust the generator frequency so that the pointer of the left-hand meter points to the right end of the red mark and adjust for maximum phase indication. The difference in the phase angle $\Delta\varphi$ should be $\leqq 1^{\circ}$; if this is not the case, realign the IF circuits (section 10).

7.5 Checking the Spread Chart Range

Insert the Smith chart (Fig. 1) as impedance chart into the chart holder. Short the coaxial test line and the coaxial reference line, adjust the generator for any desired frequency and tune the Z-g Diagraph to this frequency. Adjust the generator voltage so that the crosslines of the light spot lie on the outermost chart circle. The INDICATION switch is at SPREAD. If you then switch to NORMAL, the crosslines should indicate 0.5 on the real axis of the chart. If this is not the case, readjust the sensitivity of the galvanometer for both ranges, starting with the SPREAD range. With the coaxial test line and the coaxial reference line shorted, feed in a signal of any convenient frequency and tune the Z-g Diagraph to this frequency. Next, adjust the voltage at the generator so that the right-hand meter points to 1/3 of full deflection (33.3 scale marks). The crosslines of the light spot should then be on the outermost chart circle. If this is not the case, correct using the variable resistor R206 (Fig. 16). If you now switch to NORMAL, the crosslines should be at

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0.5. If this value is not reached exactly, correct by means of resistor R204 (Fig. 16). Increase the voltage at the generator to give full scale deflection (100 scale marks, red mark); the crosslines should again go to the outermost chart circle.

7.6 Checking the Zeroing of the Galvanometer

Valve R819 (Fig. 13) serves to compensate for the zero signal current of the meter diode R812 (Fig. 14) and to linearize its characteristic. The electrical zero is correct if upon switching from NORMAL to SPREAD the zero deflection of the light spot remains unchanged or shifts to the left by a maximum of 1 mm. This small shift is caused by noise. For this investigation, the generator should be cut off. If the shifting of the light spot upon switching is more than 1 mm, zero by using resistor R207 (Fig. 16). If adjustment with R207 is not possible, the two valves R812 and R819 (EA 50) have aged differently and should be replaced (section 9.1.10 and 9.1.12).

8. Trouble Shooting

Should after a certain service time an irregularity occur in the set, the following hints may help to locate the defect. In most cases it will thus be possible to find and to remedy the trouble.

8.1 Pilot Lamp R13 Does not Light

(a) Check AC supply voltage;

(b) Check fuse Si1 in power section (Fig. 13);

(c) Check pilot lamp R13;

(d) Check power circuit in the set.

8.2 No Light Spot

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(a) Check that the set is in horizontal position;

(b) Check mechanical zero, HORIZONTAL, VERTICAL;

(c) Check projector lamp R12 (Fig. 16);

(d) Check socket of projector lamp; after replacement obtain maximum brightness of light spot by turning and adjusting lamp vertically.

(e) Galvanometer (Fig. 15) defective;

(f) Trouble in mirror case (Fig. 15).

8.3 No Pointer Deflection on Both Meters and on Galvanometer

(a) Check AC supply voltage;

(b) Check input voltage of signal generator (feeder);

(c) Check anode voltage across contact No. 9 of multi-point connector C (section 7.1a); rating: 220 v ±5%;

(d) Check filament voltage across contact No. 3 of multi-point connector C (section 7.1b); rating: 6.5 v AC ±3%.

8.4 Anode Supply Voltage Cannot be Adjusted to Rating, Stabilization Insufficient

Disconnect set from power supply. Check resistance to chassis at contact No. 9 of multi-point connector C (Figs. 13 and 15). Rating of resistance R = 10 kΩ. If R > 10 kΩ, check R821 to R825 in the power section and replace, if necessary. If R < 10 kΩ, check the capacitors in the anode leads.

8.5 Filament Voltage Cannot be Adjusted to Rated Value, Stabilization Insufficient

Check valves R817 and R818 in the power supply. Replace lamp R11 if these valves are satisfactory. If necessary, also check the capacitors and resistors which are in circuit with R817 and R818.

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8.6 No Light Spot Deflection and, at the Same Time, Phase Maximum not Obtainable

Check valves R88 (Fig. 15), R89 (Fig. 17), R810, R811, R813 and R814 in the test receiver (Fig. 14) and valves R815 and R816 in the phase amplifier, to find out whether the operating voltages of these valves are present. Mixer diode G110, too, may be the cause of trouble. When re-

placing this crystal diode, refer to section 9.2, when replacing a valve, to section 9.1. Do not interchange the valves.

8.7 No Light Spot Deflection, Phase Maximum Well Obtainable

(a) Check R812 (section 9.1.10);

(b) Check galvanometer. Apply -10 v DC via 200 kΩ between chassis (+) and contact No. 6 of multi-point connector B (Fig. 14). This should give full deflection in the SPREAD range.

8.8 No Deflection on Reference Meter, no Phase Maximum Obtainable

Check valves R81, R82, R83 and R84 in the reference receiver (Fig. 14), valve R87 (Fig. 15) and valves R815 and R816 in the phase amplifier (Fig. 14). Check that the operating voltages of these valves are present. Mixer diode G19, too, may be the cause of trouble. When replacing the crystal diode, refer to section 9.2, when replacing one of the valves, refer to section 9.1.

8.9 No Deflection on Right-hand Meter, Phase Maximum Obtainable

Check right-hand meter. Apply 30 v DC through 300 kΩ between chassis and contact No. 6 of multi-point connector A (Fig. 14). This voltage should yield about full deflection. The deflection also depends on the adjustment of resistors R188 (Fig. 18) and R189. With R189 the reference voltage can be corrected from the front panel.

8.10 No Resonance Indication, Amplitude and Phase Indication Satisfactory

(a) If the pointer is always on mid-position, there may be a breakdown of valve R85 (Fig. 14) or its operating voltage.

(b) If the pointer is always at the left-hand stop, check valve R86 (Fig. 13) and replace, if necessary. Check also the push button below the left-hand meter and incandescent lamp R11 for troublefree operation. Also check the anode fuse Si2 (Fig. 13).

(c) If the pointer is always at the right-hand stop, a short between the electrodes of valve R86 may be suspected. Check also the push-button switch and incandescent lamp R11 for accidental contact to chassis.

(d) If during tuning the pointer deflects only to the right or only to the left, the trouble will be in the discriminator. Check crystal diodes G11 and G12, which are in the circuit of valve R86. For adjustment see instructions of section 10.

8.11 Phase Meter Shows Only Very Flat or no Maximum, Amplitude and Resonance Indication Satisfactory

(a) The signal generator might be modulated or introduce considerable hum. If this is not the case,

(b) try to improve maximum with R47 (Fig. 13). Short coaxial test line and coaxial reference line, adjust for phase maximum as well as possible and make the maximum as sharp as possible by means of R47. Readjust the maximum several times. Turn the chart by 360° and readjust to maximum. If this maximum is not sharp, adjust for the same and optimum sharpness of the two maxima. Sharpness of the maximum and amplitude of the deflection depend upon one another.

8.12 Left-hand Meter Shows Permanent Deflection

(a) Check valves R815 and R816 and their operating voltages;

(b) Check crystal diode G15, which lies in the anode circuit of valve R815;

(c) If necessary, readjust the circuits of the amplifiers. See section 10.3.

8.13 During Amplitude Adjustment the Right-hand Meter Cannot be Set to 100%

First try to readjust R188 (Fig. 18) so that 100% full deflection can be obtained with the knob REFERENCE VOLTAGE COR. when the signal-generator voltage is so adjusted that with the coaxial test line and the coaxial reference line shorted the crosslines of the light spot are at the maximum circle of chart.

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If this is not possible and if the reference voltage is always less than 100%, the trouble is in the reference receiver. If, however, the reference voltage is always greater than 100%, the trouble is in the test receiver.

In both cases, check respectively valves R81, R82, R83, R84 and R87, or R88, R810, R811, R813 and R814. If a replacement of valves becomes necessary, observe section 9.1.

8.14 In Spite of Amplitude and Phase Adjustment Made at a Medium Frequency (100 Mc) the Amplitude Error or Phase Error Exceeds the Specified Tolerances at Other Frequencies

Check diodes G19 and G110 (in the mixer head). Both diodes should have equal input impedances and their characteristic should be roughly identical. The check on the characteristics is not particularly critical and can be made by a point-by-point method using DC. In the cut-off region, a current of less than 20 µa should flow at 0.5 v, in the pass-band region the current should be more than 0.5 ma at +0.3 v. The forward current of the two diodes should be as equal as possible. The selection for equal input impedance is preferably made in the mixer head itself. Always replace one of the two diodes until a suitable pair has been found. Matched pairs of diodes may be ordered from ROHDE & SCHWARZ by specifying the Serial Number (FNr.) of the set. However, a better frequency response will be obtained when selecting the diodes by inserting them in the mixer head as described above, since this will take care of any slight unbalance of the mixer head.

8.15 Amplitude Difference between Short-circuit and Open-circuit Measurements Exceeds Tolerance

Check resistance of the matching elements. With the "Input" open-circuited, Z_o ±1% should be measured at the connectors of the coaxial reference line and coaxial test line. If the resistance differs from the Z_o rating, replacement and elimination of the trouble can be made at the factory only. This amplitude difference may also be caused by an erroneous adjustment of the directional couplers In this case again repair can only be made at the factory.

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8.16 Light Spot Shows More than 1% Reflection with Exact Z_o Termination of the Coaxial Test Line, e.g., with UHF Standard Resistor Type RMD

(a) Check mechanical zero with respect to VERTICAL and HORIZONTAL, with the signal generator disconnected from the input of the Type ZDU.

(b) Check terminating resistor used. Repeat measurement using another terminating resistor.

(c) Trouble in directional coupler. Replacement and readjustment only possible at our factory.

8.17 Phase Maximum Cannot be Adjusted to ZERO or 360° Though Use is Made of the Knob PHASE COR.

(a) Check contact making of the two short-circuit terminations FZ 434 with reference and test line.

(b) Check that mechanical drive for C24 (cord drive Fig. 14) is satisfactory.

(c) Check that the test line is tightened up to the stop.

(d) If necessary, readjust the reference and test receivers according to section 10.3.

8.18 Phase Maximum after Adjustment to 0° Does not Agree with Phase Maximum after 360° Rotation of Chart by Means of PHASE ADJ.

Zero frequency of discriminator is incorrect. Readjust discriminator and amplifier in accordance with section 10.

9. Maintenance

The Z-g Diagraph Type ZDU does not require any routine servicing. After a long time of operation, it may be possible that the brightness of the light spot of the galvanometer considerably decreases. This is due to dust covering the mirrors and the plexiglass screen. After removing the six screws, the plexiglass screen can be removed and easily be cleaned. To obtain access to the mirror case (Fig. 15), take the set out of its cabinet and remove the power supply. When taking off the lid, the mirrors and the window of the galvanometer can be cleaned from dust. It is, however, necessary to exercise great care. Do not exert pressure on the mirrors, so as not to change the path of the rays. Use only a very soft and clean piece of leather for cleaning, since the surfaces of all mirrors contained in the mirror case are silver-plated and liable to be scratched.

9.1 Replacement of Valves

9.1.1 R81, R82, R83, R84

Allow a warm-up period of one hour after insertion of the new valve; carefully adjust the IF circuits before and behind the valve to obtain maximum amplitude. See also section 10.3.

9.1.2 R85

No adjustment necessary.

9.1.3 R86

After inserting the new valve, adjust the quiescent DC anode current in accordance with section 7.3.

9.1.4 R87, R88

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No adjustment necessary.

9.1.5 R810, R811, R813, R814

Same as under 9.1.1.

9.1.6 R815

Adjust C176, see section 10.3.3.

9.1.7 R816

Adjust C176 and C182, see section 10.3.3.

9.1.8 R821, R822, R823, R824 and R825

Adjust R172 (Fig. 13) so that the anode-supply voltage is 220 v. See also section 7.1.a.

9.1.9 R89

Insert the valve (Fig. 17), allow the instrument to warm up and make a few measurements in the frequency range 180 to 200 Mc. If the UHF characteristics of the oscillator valve appreciably differ from average, interruptions in oscillation or parasitic oscillations may occur.

9.1.10 R812

Loosen the two screws at the rear outer wall of the IF section (Fig. 14) and remove the base cover of the test receiver; pull the socket of R812 (EA 50) downward and replace the valve after removal of the anode cap. Put the socket and the base cover of the IF section back in place and switch on the set. After a warm-up period of a few minutes has elapsed, adjust the electrical zero of the galvanometer with R207 (Fig. 16). See also section 7.6.

9.1.11 R817, R818

Check filament voltage after replacement of the valves. See section 7.1b.

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9.1.12 R819

Adjust electrical zero of the galvanometer after replacement of the valve, as set forth in section 7.6.

9.2 Replacement of Diodes G19 and G110

These diodes are housed in the compartments of valves R87 and R88 (Fig. 15). Note: Protect diodes from shocks and static charge. Refer to section 8.14.

10. Alignment of the IF Circuits

The rated intermediate frequency of the Z-g Diagraph is the frequency for which the artificial line has a length of exactly π.

10.1 Finding the Rated IF

Allow a warm-up period of about one hour. Check the quiescent DC anode current of R86 according to section 7.3. Short both coaxial lines. Using a power signal generator of high frequency stability, apply a voltage to the input of the Z-g Diagraph, the frequency of which is equal to the intermediate frequency of the Type ZDU, which is between 10 and 11 Mc. Adjust the frequency of the signal generator so that the pointer of the left-hand meter is exactly at the centre mark. Do not press the button. The position of the FREQUENCY knob, i.e., the oscillator tuning in the Type ZDU, is of no importance. Short the coaxial reference line and the coaxial test line each by a short-circuit connector FZ 434. Adjust the amplitude of the signal generator so that the right-hand meter shows approximately full deflection. Insert a chart which shows a division in degrees on its outermost circle (Fig. 4 or Fig. 5). Press the button. It will remain depressed even if not pressed any longer. Adjust for maximum deflection on the left-hand meter using the PHASE ADJ. knob and find the phase angle on the chart. Next, turn the chart by 360° using the PHASE ADJ. knob and again adjust for maximum. The same phase angle as before will then be obtained if the IF is correct and the discriminator is tuned to this frequency. A phase angle deviation of $\pm 0.5^\circ$ is permissible. If the deviation is greater, repeat the above measurement with another frequency. Use a higher frequency if for finding the second phase maximum the chart must be rotated more than 360°. Use a lower frequency if the angle of rotation was smaller than 360°. For every degree, change the frequency by about 30 kc.

10.2 Adjustment of the Discriminator

If you have thus obtained the rated IF, i.e., the one for which the artificial line has a length of π, press the button. This button is thus released and switches the meter over for tuning indication. It can now be seen that, due to the previous frequency detuning, the pointer of the meter is no longer on the centre mark. Adjust the discriminator to the new IF. To do this, slightly turn the trimmer C46 (Fig. 14) by only a few degrees of angle, until the pointer of the left-hand meter again points to the centre mark. Do not change the frequency at the signal generator between adjustment for the rated IF (according to section 10.1) and retuning the discriminator. For this reason, it is also imperative that the signal generator have a high frequency stability. Use a tuning wand of insulating material for retuning the discriminator.

10.3 Adjustment of the Individual Circuits

10.3.1 Reference Receiver

Apply a signal as set forth in section 10.1. Also short coaxial test line and coaxial reference line with FZ 434. For the duration of the tuning procedure described in the following, the signal-generator frequency should be kept constant. It is, therefore, advisable to check this frequency several times with the aid of the left-hand meter. The pointer of this meter should always exactly point to the centre line over the red mark. After a warm-up period of at least one hour, adjust successively:

(a) C3, C10 and C19 (Fig. 14) for maximum amplitude at the right-hand meter. Adjust very carefully and repeat the procedure several times.

(b) C26 (Fig. 14) for amplitude maximum. As tuning indicator connect a 50-µa moving-coil meter between test point 11 (Fig. 14) and chassis.

(c) C34 for amplitude maximum. As tuning indicator connect a 50-µa moving-coil meter between test point 13 (Fig. 14) and chassis.

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C42 (Fig. 14) should be readjusted only after a repair on the discriminator (amplitude maximum). As tuning indicator connect a 50-µa moving-coil meter between test point 15 (Fig. 15) and chassis.

10.3.2 Test Receiver

The conditions under which the adjustment must be made, are the same as for the adjustment of the reference receiver (section 10.3.1). On the test receiver, adjust successively:

(a) C130, C137 and C146 (Fig. 14) for amplitude maximum at the light spot galvanometer. Adjust carefully and repeat the procedure several times.

(b) C156 for amplitude maximum. As tuning indicator connect a 50-µa moving-coil meter between test point 12 (Fig. 14) and chassis.

(c) C163 for amplitude maximum. As tuning indicator connect a 50-µa moving-coil meter between test point 14 (Fig. 14) and chassis.

10.3.3 Phase Meter Amplifier

The conditions for adjustment are the same as set forth in sections 10.3.1 and 10.3.2. Adjust C176 and C182. Depress the button. Using the PHASE COR. knob, bring the phase close to the maximum indication on the left-hand meter and adjust for minimum pointer deflection alternately using C176 and C182. Adjust the phase still closer to maximum and repeat the adjustment. The position of C182 is shown in Fig. 14. C176 is not visible there. It is located in the shielding can behind R815 and is accessible from above. For this purpose, loosen the five countersunk bolts and remove the power section, which is located on a separate frame and inserted on top (Fig. 13). Connect the female multi-way connector of the power section to the male multi-way connector of the set via a suitable cable so that operation of the set is possible with the power section removed.

After the phase meter amplifier is adjusted, check its sensitivity. For this purpose, disconnect cable K4 (Fig. 14) from the test receiver and connect this amplifier to a standard signal generator, e.g. the R&S Type SMAF BN 41401, via a cable, which has a capacitance of 91 pf just as K4, and via 5 pf. Tune the standard signal generator to the IF of the Type ZDU. For tuning indicator, use the left-hand meter; press the button below it and tune for minimum deflection. This tuning should be made with a signal-generator output voltage of 2 mv. Decrease the signal-generator voltage to 0 by disconnecting the patch cord and check that the pointer

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deflection of the left-hand meter increases by at least 10% in the direction marked by the arrow. If the sensitivity is not sufficient, check valves RÖ15 and RÖ16. The crystal diode G15, too, may be a cause of insufficient sensitivity. Check these circuit elements also if a minimum adjustment is impossible or if the sharpness of the minimum adjustment is insufficient.

11. Table of Replaceable Parts

Ref. No.	Designation	Ratings	R&S Stock No.
C1	Capacitor, synth. foil	10,000 pf/250 v	CKS 10 000/250
C2	Capacitor, ceramic	47 pf 10 pf	CCH 31/47 CCH 31/10 parallel
C3	Trimmer, air	2.5 to 8.9 pf	CV 63206
C4	Capacitor, ceramic	150 pf	CCH 68/150
C5	Capacitor, synth. foil	10,000 pf/500 v	CKS 10 000/500
C6	Capacitor, synth. foil	10,000 pf/125 v	CKS 10 000/125
C7	Capacitor, synth. foil	10,000 pf/250 v	CKS 10 000/250
C8	Capacitor, synth. foil	10,000 pf/250 v	CKS 10 000/250
C9	Capacitor, ceramic	39 pf 6 pf 8 pf	CCH 31/39 CCG 41/6 CCG 68/8 parallel
C10	Trimmer, air	2.5 to 8.9 pf	CV 63206
C11	Capacitor, ceramic	150 pf	CCH 68/150
C12	Capacitor, synth. foil	10,000 pf/250 v	CKS 10 000/250
C13	Capacitor, synth. foil	10,000 pf/125 v	CKS 10 000/125
C14	Capacitor, synth. foil	10,000 pf/250 v	CKS 10 000/250
C15	Capacitor, ceramic	5 pf	CCG 68/5
C16	Capacitor, ceramic	5 pf	CCG 11/5
C17	Capacitor, ceramic	150 pf	CCH 68/150
C18	Capacitor, ceramic	39 pf 8 pf 8 pf	CCH 31/39 CCG 41/8 CCG 68/8 parallel
C19	Trimmer, air	2.5 to 8.9 pf	CV 63206
C20	Capacitor, ceramic	150 pf	CCH 68/150
C21	Capacitor, synth. foil	10,000 pf/250 v	CKS 10 000/250
C22	Capacitor, synth. foil	10,000 pf/250 v	CKS 10 000/250
C23	Capacitor, synth. foil	10,000 pf/250 v	CKS 10 000/250

Ref. No.	Designation	Ratings	R&S Stock No.
C24	Trimmer, air		included in 3561 - 6
C25	Capacitor, ceramic	33 pf 8 pf	CCH 31/33 CCG 68/8 parallel
C26	Trimmer, air	2.5 to 8.9 pf	CV 63206
C27	Capacitor, ceramic	150 pf	CCH 68/150
C28	Capacitor, synth. foil	10,000 pf/250 v	CKS 10 000/250
C29	Capacitor, synth. foil	10,000 pf/250 v	CKS 10 000/250
C30	Capacitor, synth. foil	10,000 pf/250 v	CKS 10 000/250
C31	Trimmer, air	3 to 28 pf	CV 65225
C32	Trimmer, air	3 to 28 pf	CV 65225
C33	Capacitor, ceramic	18 pf 2 pf	CCH 31/18 CCG 41/2 parallel
C34	Trimmer, air	2.5 to 8.9 pf	CV 63206
C35	Capacitor, ceramic	100 pf	CCH 31/100
C36	Capacitor, ceramic	150 pf 15 pf 150 pf	CCH 31/150 CCH 55/15 CCH 68/150 parallel
C37	Capacitor, ceramic	4 pf	CCG 41/4
C38	Capacitor, synth. foil	250 pf	CKS 10 000/250
C39	Capacitor, synth. foil	250 pf	CKS 10 000/250
C40	Capacitor, ceramic	0.5 pf	CCG 11/0,5
C41	Capacitor, feed-through, ceramic	2000 pf	CFS 2000
C42	Trimmer, air	2.5 to 8.9 pf	CV 63206
C43	Capacitor, ceramic	47 pf 15 pf 10 pf	CCH 31/47 CCH 31/15 CCG 68/10 parallel
C44	Capacitor, ceramic	150 pf	CCH 68/150
C45	Capacitor, ceramic	22 pf 12 pf 3 pf	CCH 31/22 CCH 31/12 CCG 55/3 parallel
C46	Trimmer, air	2.5 to 8.9 pf	CV 63206

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Ref. No.	Designation	Ratings	R&S Stock No.
C47	Capacitor, ceramic	150 pf	CCH 68/150
C48	Capacitor, synth. foil	10,000 pf/250 v	CKS 10 000/250
C49	Capacitor, feed-through, ceramic	2000 pf	CFS 2000
C50	Capacitor, feed-through, ceramic	2000 pf	CFS 2000
C51	Capacitor, MP	2 µf/160 v	CMR 2/160/2
C52	Capacitor, ceramic	5 pf	CCG 68/5
C53	Capacitor, ceramic	5 pf	CCG 11/5
C54	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C55	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C56	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C57	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C58	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C59	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C60	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C61	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C62	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C63	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C64	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C65	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C66	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500

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Ref. No.	Designation	Ratings	R&S Stock No.
C67	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C68	Capacitor, feed-through, ceramic	2000 pf	CFS 2000
C69	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C70	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C71	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C72	Capacitor, synth. foil	10,000 pf/500 v	CKS 10 000/500
C73	Capacitor, synth. foil	2500 pf/500 v	CKS 2500/500
C75	Capacitor, bypass	60 to 70 pf	incl. in 3561-70.3
C76	Capacitor, bypass	115 to 120 pf	incl. in 3561-70.3
C77	Capacitor, ceramic	15 pf 6 pf	CCH 31/15 CCG 55/6 parallel
C78	Capacitor, ceramic	1000 pf	CCG 94/1000
C79	Capacitor, synth. foil	10,000 pf/125 v	CKS 10 000/125
C81	Capacitor, feed-through	2000 pf	CFS 2000/M 5
C82	Capacitor, feed-through	2000 pf	CFS 2000/M 5
C83	Capacitor, feed-through	2000 pf	CFS 2000/M 5
C84	Capacitor, feed-through	2000 pf	CFS 2000/M 5
C85	Capacitor, feed-through	2000 pf	CFS 2000/M 5
C86	Capacitor, feed-through	2000 pf	CFS 2000/M 5
C87	Capacitor, feed-through	2000 pf	CFS 2000/M 5
C88	Capacitor, feed-through	2000 pf	CFS 2000/M 5
C89	Capacitor, bypass	C75 ±1%	incl. in 3561-70.2
C90	Capacitor, bypass	C76 ±1%	incl. in 3561-70.2
C91	Capacitor, ceramic	15 pf 6 pf	CCH 31/15 CCG 55/6 parallel
C92	Capacitor, ceramic	1000 pf	CCG 94/1000

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Ref. No.	Designation	Ratings	R&S Stock No.
C93	Capacitor, synth. foil	10,000 pf/125 v	CKS 10 000/125
C95	Capacitor, feed-through	2000 pf	CFS 2000/M 5
C96	Capacitor, feed-through	2000 pf	CFS 2000/M 5
C97	Capacitor, feed-through	2000 pf	CFS 2000/M 5
C98	Capacitor, feed-through	2000 pf	CFS 2000/M 5
C99	Capacitor, feed-through	2000 pf	CFS 2000/M 5
C100	Capacitor, feed-through	2000 pf	CFS 2000/M 5
C101	Capacitor, feed-through	2000 pf	CFS 2000/M 5
C102	Capacitor, feed through	2000 pf	CFS 2000/M 5
C103	Capacitor, bypass	approx. 55 pf	incl.in 3561-70.16
C104	Capacitor, ceramic	150 pf 39 pf	CCH 31/150 CCH 31/39 parallel
C105	Capacitor, bypass	450 to 520 pf	incl.in 3561-70.16
C106	Capacitor, bypass	C105 $\pm$1%	incl.in 3561-70.16
C107	Capacitor, bypass	approx. 25 pf	incl.in 3561-70.16
C108	Capacitor, bypass	C107 $\pm$1%	incl.in 3561-70.16
C109	Capacitor, ceramic	0.5 pf	CCG 11/0,5
C110	Capacitor, ceramic	0.5 pf	CCG 11/0,5
C111	Capacitor, variable	approx. 4 to 12 pf	incl.in 3561-70
C112	Capacitor, bypass	approx. 7.5 pf	incl.in 3561-70
C113	Capacitor, bypass	> 50 pf	incl.in 3561-70
C115	Capacitor, feed-through	2000 pf	CFS 2000/M 5
C116	Capacitor, feed-through	2000 pf	CFS 2000/M 5
C117	Capacitor, feed through	2000 pf	CFS 2000/M 5
C118	Capacitor, feed-through	2000 pf	CFS 2000/M 5
C119	Capacitor, feed-through	2000 pf	CFS 2000/M 5
C120	Capacitor, feed-through	2000 pf	CFS 2000/M 5
C121	Capacitor, feed-through	2000 pf	CFS 2000/M 5

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Ref. No.	Designation	Ratings	R&S Stock No.
C122	Capacitor, feed-through	2000 pf	CFS 2000/M 5
C123	Capacitor, feed-through	2000 pf	CFS 2000
C124	Capacitor, feed-through	2000 pf	CFS 2000
C128	Capacitor, synth. foil	10,000 pf/250 v	CKS 10 000/250
C129	Capacitor, ceramic	47 pf 10 pf	CCH 31/47 CCH 31/10 parallel
C130	Trimmer, air	2.5 to 8.9 pf	CV 63206
C131	Capacitor, ceramic	150 pf	CCH 68/150
C132	Capacitor, synth. foil	10,000 pf/250 v	CKS 10 000/250
C133	Capacitor, synth. foil	10,000 pf/125 v	CKS 10 000/125
C134	Capacitor, synth. foil	10,000 pf/250 v	CKS 10 000/250
C135	Capacitor, synth. foil	10,000 pf/250 v	CKS 10 000/250
C136	Capacitor, ceramic	39 pf 4 pf 8 pf	CCH 31/39 CCG 41/4 CCG 68/8 parallel
C137	Trimmer, air	2.5 to 8.9 pf	CV 63206
C138	Capacitor, ceramic	150 pf	CCH 68/150
C139	Capacitor, synth. foil	10,000 pf/250 v	CKS 10 000/250
C140	Capacitor, synth. foil	10,000 pf/125 v	CKS 10 000/125
C141	Capacitor, synth. foil	10,000 pf/250 v	CKS 10 000/250
C144	Capacitor, ceramic	150 pf	CCH 68/150
C145	Capacitor, ceramic	10 pf 8 pf	CCH 31/10 CCG 68/8 parallel
C146	Trimmer, air	2.5 to 8.9 pf	CV 63206
C147	Capacitor, ceramic	150 pf	CCH 31/150
C148	Capacitor, ceramic	56 pf	CCH 31/56
C149	Capacitor, ceramic	150 pf	CCH 68/150
C150	Capacitor, synth. foil	10,000 pf/250 v	CKS 10 000/250
C151	Capacitor, synth. foil	10,000 pf/250 v	CKS 10 000/250

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Ref. No.	Designation	Ratings	R&S Stock No.
C152	Capacitor, synth. foil	10,000 pf/250 v	CKS 10 000/250
C155	Capacitor, ceramic	39 pf 6 pf 8 pf	CCH 31/39 CCG 41/6 CCG 68/8 parallel
C156	Trimmer, air	2.5 to 8.9 pf	CV 63206
C157	Capacitor, ceramic	150 pf	CCH 68/150
C158	Capacitor, synth. foil	10,000 pf/250 v	CKS 10 000/250
C159	Capacitor, synth. foil	10,000 pf/250 v	CKS 10 000/250
C160	Capacitor, synth. foil	10,000 pf/250 v	CKS 10 000/250
C161	Capacitor, ceramic	0.5 pf	CCG 11/0,5
C162	Capacitor, ceramic	22 pf	CCH 31/22
C163	Trimmer, air	2.5 to 8.9 pf	CV 63206
C164	Capacitor, ceramic	150 pf 15 pf 150 pf	CCH 31/150 CCG 55/15 CCH 68/150 parallel
C165	Capacitor, ceramic	100 pf	CCH 31/100
C166	Capacitor, synth. foil	10,000 pf/250 v	CKS 10 000/250
C169	Capacitor, ceramic	47 pf	CCH 68/47
C170	Capacitor, synth. foil	10,000 pf/250 v	CKS 10 000/250
C171	Capacitor, synth. foil	1000 pf/500 v	CKS 1000/500
C172	Capacitor, feed-through, ceramic	2000 pf	CFS 2000
C173	Capacitor, synth. foil	10,000 pf/125 v	CKS 10 000/125
C174	Capacitor, ceramic	150 pf	CCH 68/150
C175	Capacitor, ceramic	22 pf	CCH 31/22
C176	Trimmer, air	2.5 to 8.9 pf	CV 63206
C177	Capacitor, synth. foil	10,000 pf/250 v	CKS 10 000/250
C178	Capacitor, synth. foil	10,000 pf/250 v	CKS 10 000/250
C179	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500

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Ref. No.	Designation	Ratings	R&S Stock No.
C180	Capacitor, ceramic	150 pf	CCH 68/150
C181	Capacitor, ceramic	12 pf	CCH 31/12
C182	Trimmer, air	2.5 to 8.9 pf	CV 63206
C185	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C186	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C187	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C188	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C189	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C190	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C191	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C192	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C193	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C194	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C195	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C196	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C197	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C198	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C199	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C200	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500

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Ref. No.	Designation	Ratings	R&S Stock No.
C201	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C202	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C203	Capacitor, synth. foil	10,000 pf/500 v	CKS 10 000/500
C206	Capacitor, MP	1 µf/250 v	CMR 1/250
C207	Capacitor, MP	1 µf/250 v	CMR 1/250
C208	Capacitor, MP	1 µf/250 v	CMR 1/250
C209	Capacitor, MP	1 µf/250 v	CMR 1/250
C210	Capacitor, MP	1 µf/250 v	CMR 1/250
C211	Capacitor, MP	2 µf/160 v	CMR 2/160/2
C212	Capacitor, MP	0.5 µf/500 v 0,25 pf/500 v	CMR 0,5/500 CMR 0,25/500 parallel
C213	Capacitor, synth. foil	15,000 pf/500 v	CKS 15 000/500
C214	Capacitor, paper	100,000 pf/250 v	CPK 100 000/250
C215	Capacitor, MP	16 µf/350 v	CMR 16/350
C216	Capacitor, MP	16 µf/350 v	CMR 16/350
C217	Capacitor, synth. foil	5000 pf/500 v	CKS 5000/500
C220 : C325	Capacitor, tubular	4.3 pf ±1%	CT 4,3 ±1%
G11	Diode, crystal		GK 2551
G12	Diode, crystal		GK 2551
G13	Diode, crystal		GK 1111
G14	Diode, crystal		GK 2551
G15	Diode, crystal		GK 2551
G16	Diode, crystal		GK 2551
G17	Diode, crystal		GK 2551

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Ref. No.	Designation	Ratings	R&S Stock No.
G18	Diode, crystal		GK 2551
G19	Diode, crystal		GK 1011 C
G110	Diode, crystal		GK 1011 C
I1	Ammeter, moving-coil		IBS 10101
I2	Ammeter, moving-coil, light-spot		IG 2
I3	Ammeter, moving-coil		IBS 20201
K1	Cable, RF		3561 - 40
K2	Cable, RF		3561 - 40
K3	Cable, RF		3561 - 41
K4	Cable, RF		3561 - 12
K5	Cable, RF		3561 - 41
K6	Cable, RF		LKF 53172/450
K7	Patch cord		LK 333
L1	Coil, filter		3561 - 6.15.3
L2	Coil, filter		3561 - 6.16.3
L3	Coil, filter		3561 - 6.16.3
L4	Coil, filter		3561 - 6.16.3
L5	Coil, filter		3561 - 6.18.1
L6	Coil, filter		3561 - 6.18.1
L7	Coil, filter		3561 - 6.19.5
L8	Choke, RF		DUF 311/20
L9	Choke, RF		DUF 311/20
L10	Choke, RF		DUF 311/20
L11	Coil, IF		3561 - 70.2.9

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Ref. No.	Designation	Ratings	R&S Stock No.
L12	Coil, IF		3561 - 70.2.9
L13	Choke, RF		3561 - 7.4.8
L14	Choke, RF		3561 - 7.4.8
L15	Choke, RF		3561 - 7.4.8
L16	Choke, RF		3561 - 7.4.8
L17	Choke, RF		3561 - 7.4.8.
L18	Choke, RF		3561 - 7.4.8
L19	Choke, RF		3561 - 7.4.8
L20	Choke, RF		3561 - 7.4.8
L21	Choke, RF		3561 - 7.4.8
L22	Choke, RF		3561 - 7.4.8
L23	Choke, RF		3561 - 7.4.8
L24	Choke, RF		3561 - 7.4.8
L27	Coil (trap)		3561 - 7.6
L28	Coil, oscillator		3561 - 7.56
L29	Coil, oscillator		3561 - 7.57
L30	Coil, oscillator		3561 - 7.58
L31	Coil, oscillator		3561 - 7.59
L32	Coil, oscillator		3561 - 7.60
L33	Coil, oscillator		3561 - 7.61
L35	Choke, RF		3561 - 7.4.8
L36	Choke, RF		3561 - 7.4.8
L37	Choke, RF		3561 - 7.4.8
L38	Choke, RF		3561 - 7.4.8
L39	Choke, RF		3561 - 7.4.8
L40	Choke, RF		3561 - 7.4.8
L43	Coil, filter		3561 - 6.15.3

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Ref. No.	Designation	Ratings	R&S Stock No.
L44	Coil, filter		3561 - 6.16.3
L45	Coil, filter		3561 - 6.16.3
L46	Coil, filter		3561 - 6.16.3
L47	Coil, filter		3561 - 6.18.1
L48	Coil, filter		3561 - 6.19.5
L49	Coil, filter		3561 - 8.12.5
L50	Choke, RF		DUF 311/20
L51	Choke, RF		DUF 311/20
L52	Choke, RF		DUF 311/20
L55	Coil, ring		incl.in 3561-4.8
R1	Resistor, depos. carbon	300 Ω/0.25 w	WF 300/0,25
R2	Resistor, depos. carbon	200 kΩ/0.25 w	WF 200 k/0,25
R3	Resistor, depos. carbon	1 kΩ/0.5 w	WF 1 k/0,5
R4	Resistor, depos. carbon	200 Ω/0.25 w	WF 200/0,25
R5	Resistor, depos. carbon	20 kΩ/0.5 w	WF 20 k/0,5
R6	Resistor, depos. carbon	300 Ω/0.25 w	WF 300/0,25
R7	Resistor, depos. carbon	200 kΩ/0.25 w	WF 200 k/0,25
R8	Resistor, depos. carbon	1 kΩ/0.5 w	WF 1 k/0,5
R9	Resistor, depos. carbon	200 Ω/0.25 w	WF 200/0,25
R10	Resistor, depos. carbon	20 kΩ/0.5 w	WF 20 k/0,5
R11	Resistor, depos. carbon	12.5 kΩ/0.25 w	WF 12,5 k/0,25
R13	Resistor, depos. carbon	100 kΩ/0.25 w	WF 100 k/0,25
R14	Resistor, depos. carbon	1 kΩ/0.5 w	WF 1 k/0,5
R15	Resistor, depos. carbon	100 kΩ/0.5 w	WF 100 k/0,5
R16	Resistor, depos. carbon	200 kΩ/0.5 w	WF 200 k/0,5
R17	Resistor, depos. carbon	200 kΩ/0.25 w	WF 200 k/0,25

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Ref. No.	Designation	Ratings	R&S Stock No.
R18	Resistor, depos. carbon	1 kΩ/0.5 w	WF 1 k/0,5
R19	Resistor, depos. carbon	500 kΩ/0.25 w	WF 500 k/0,25
R20	Resistor, depos. carbon	1 MΩ/0.25 w	WF 1 M/0,25
R21	Resistor, depos. carbon	100 kΩ/0.5 w	WF 100 k/0,5
R22	Resistor, depos. carbon	500 Ω/0.25 w	WF 500/0,25
R23	Resistor, depos. carbon	125 kΩ/0.25 w	WF 125 k/0,25
R24	Resistor, depos. carbon	585 Ω ±1%/0.25 w	WF 585/1/0,25
R25	Resistor, depos. carbon	200 kΩ/0.25 w	WF 200 k/0,25
R26	Resistor, depos. carbon	1 kΩ/0.5 w	WF 1 k/0,5
R27	Resistor, depos. carbon	50 kΩ/0.25 w	WF 50 k/0,25
R28	Resistor, depos. carbon	20 kΩ/0.5 w	WF 20 k/0,5
R29	Resistor, depos. carbon	1 kΩ/0.5 w	WF 1 k/0,5
R30	Resistor, depos. carbon	100 kΩ/0.25 w	WF 100 k/0,25
R31	Resistor, depos. carbon	100 kΩ/0.25 w	WF 100 k/0,25
R32	Resistor, depos. carbon	100 kΩ/0.25 w	WF 100 k/0,25
R33	Resistor, depos. carbon	50 kΩ/0.25 w	WF 50 k/0,25
R34	Resistor, depos. carbon	100 Ω/0.25 w	WF 100/0,25
R35	Resistor, depos. carbon	1.25 kΩ/0.25 w	WF 1,25 k/0,25
R36	Resistor, depos. carbon	5 kΩ/0.5 w	WF 5 k/0,5
R37	Resistor, depos. carbon, variable	250 Ω lin.	WS 5122 F/250
R40	Resistor, depos. carbon	500 Ω/0.5 w	WF 500/0,5
R41	Resistor, depos. carbon	500 Ω/0.5 w	WF 500/0,5
R42	Resistor, depos. carbon	500 Ω/0.5 w	WF 500/0,5
R43	Resistor, depos. carbon	500 Ω/0.5 w	WF 500/0,5
R44	Resistor, depos. carbon	100 kΩ/0.5 w	WF 100 k/0,5
R45	Resistor, depos. carbon	500 Ω/0.5 w	WF 500/0,5
R46	Resistor, depos. carbon	10 kΩ/0.5 w	WF 10 k/0,5

Ref. No.	Designation	Ratings	R&S Stock No.
R47	Resistor, depos. carbon, variable	100 kΩ lin.	WS 5122 F/100 k
R48	Resistor, depos. carbon	500 Ω/0.5 w	WF 500/0,5
R49	Resistor, depos. carbon	500 Ω/0.5 w	WF 500/0,5
R52	Resistor, depos. carbon	160 Ω/0.5 w	WFO 160/0,5
R53	Resistor, depos. carbon	1 kΩ/0.5 w	WFO 1 k/0,5
R54	Resistor, depos. carbon	50 kΩ/0.5 w	WFO 50 k/0,5
R55	Resistor, depos. carbon	100 Ω ±1%/0.08 w	WFK 511/100/1/0,08
R57	Resistor, divider	25.36 Ω ±1%	3561 - 7.5.8/50
R58	Resistor, divider	25.36 Ω ±1%	3561 - 7.5.8/50
R59 R60	Resistor, divider	2 x 44.06 Ω ±0.5%	3561 - 7.5.4/50
R61	Resistor, divider	25.36 Ω ±1%	3561 - 7.5.8/50
R62	Resistor, divider	25.36 Ω ±1%	3561 - 7.5.8/50
R63	Resistor, divider	25.36 Ω ±1%	3561 - 7.5.8/50
R64	Resistor, divider	25.36 Ω ±1%	3561 - 7.5.8/50
R65 R66	Resistor, divider	2 x 44.06 Ω ±0.5%	3561 - 7.5.4/50
R67	Resistor, divider	25.36 Ω ±1%	3561 - 7.5.8/50
R68	Resistor, divider	25.36 Ω ±1%	3561 - 7.5.8/50
R57	Resistor, divider	30.43 Ω ±1%	3561 - 7.5.8/60
R58	Resistor, divider	30.43 Ω ±1%	3561 - 7.5.8/60
R59 R60	Resistor, divider	2 x 52.87 Ω ±0.5%	3561 - 7.5.4/60
R61	Resistor, divider	30.43 Ω ±1%	3561 - 7.5.8/60
R62	Resistor, divider	30.43 Ω ±1%	3561 - 7.5.8/60
R63	Resistor, divider	30.43 Ω ±1%	3561 - 7.5.8/60
R64	Resistor, divider	30.43 Ω ±1%	3561 - 7.5.8/60

only for BN 3561/50

only for BN 3561/60

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Ref. No.	Designation	Ratings	R&S Stock No.
R65, R66 (for BN 3561/60)	Resistor, divider	2 x 52.87 Ω ±0.5%	3561 - 7.5.4/60
R67 (for BN 3561/60)	Resistor, divider	30.43 Ω ±1%	3561 - 7.5.8/60
R68 (for BN 3561/60)	Resistor, divider	30.43 Ω ±1%	3561 - 7.5.8/60
R57 (only for BN 3561/75)	Resistor, divider	38.05 Ω ±1%	3561 - 7.5.8/75
R58 (only for BN 3561/75)	Resistor, divider	38.05 Ω ±1%	3561 - 7.5.8/75
R59, R60 (only for BN 3561/75)	Resistor, divider	2 x 66.09 Ω ±0.5%	3561 - 7.5.4/75
R61 (only for BN 3561/75)	Resistor, divider	38.05 Ω ±1%	3561 - 7.5.8/75
R62 (only for BN 3561/75)	Resistor, divider	38.05 ±1%	3561 - 7.5.8/75
R63 (only for BN 3561/75)	Resistor, divider	38.05 Ω ±1%	3561 - 7.5.8/75
R64 (only for BN 3561/75)	Resistor, divider	38.05 ±1%	3561 - 7.5.8/75
R65, R66 (only for BN 3561/75)	Resistor, divider	2 x 66.09 Ω ±0.5%	3561 - 7.5.4/75
R67 (only for BN 3561/75)	Resistor, divider	38.05 Ω ±1%	3561 - 7.5.8/75
R68 (only for BN 3561/75)	Resistor, divider	38.05 Ω ±1%	3561 - 7.5.8/75
R89	Resistor, depos. carbon	160 Ω/0.5 w	WFO 160/0,5
R90	Resistor, depos. carbon	1 kΩ/0.5 w	WFO 1 k/0,5
R91	Resistor, depos. carbon	50 kΩ/0.5 w	WFO 50 k/0,5
R92	Resistor, depos. carbon	100 Ω ±1%/0.08 w	WFK 511/100/1/0,08
R94	Resistor, depos. carbon	600 Ω/0.5 w	WFO 600/0,5
R95	Resistor, depos. carbon	600 Ω/0.5 w	WFO 600/0,5
R96	Resistor, depos. carbon	20 kΩ/0.5 w	WFO 20 k/0,5
R97	Resistor, depos. carbon	20 kΩ/0.5 w	WFO 20 k/0,5
R98	Resistor, depos. carbon	1 kΩ/0.05 w 6 kΩ/0.5 w	WF 1 k/0,05 WFO 6 k/0,5 in series
R99	Resistor, depos. carbon	300 Ω/1 w	WFO 300/1

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Ref. No.	Designation	Ratings	R&S Stock No.
R102	Resistor, depos. carbon	300 Ω/0.25 w	WF 300/0,25
R103	Resistor, depos. carbon	200 kΩ/0.25 w	WF 200 k/0,25
R104	Resistor, depos. carbon	1 kΩ/0.5 w	WF 1 k/0,5
R105	Resistor, depos. carbon	200 Ω/0.25 w	WF 200/0,25
R106	Resistor, depos. carbon	20 kΩ/0.5 w	WF 20 k/0,5
R107	Resistor, depos. carbon	300 Ω/0.25 w	WF 300/0,25
R108	Resistor, depos. carbon	200 kΩ/0.25 w	WF 200 k/0,25
R109	Resistor, depos. carbon	1 kΩ/0.5 w	WF 1 k/0,5
R110	Resistor, depos. carbon	200 Ω/0.25 w	WF 200/0,25
R111	Resistor, depos. carbon	20 kΩ/0.5 w	WF 20 k/0,5
R112	Resistor, depos. carbon	12.5 kΩ/0.25 w	WF 12,5 k/0,25
R114	Resistor, depos. carbon	100 kΩ/0.25 w	WF 100 k/0,25
R115	Resistor, depos. carbon	1 kΩ/0.5 w	WF 1 k/0,5
R116	Resistor, depos. carbon	160 kΩ/0.25 w	WF 160 k/0,25
R117	Resistor, depos. carbon	20 kΩ/0.25 w	WF 20 k/0,25
R118	Resistor, depos. carbon	1.6 MΩ/0.5 w	WF 1,6 M/0,5
R119	Resistor, depos. carbon	200 kΩ/0.25 w	WF 200 k/0,25
R120	Resistor, depos. carbon	1 kΩ/0.5 w	WF 1 k/0,5
R121	Resistor, depos. carbon	500 kΩ/0.25 w	WF 500 k/0,25
R122	Resistor, depos. carbon	1 MΩ/0.25 w	WF 1 M/0,25
R123	Resistor, depos. carbon	800 kΩ/0.5 w	WF 800 k/0,5
R124	Resistor, depos. carbon	125 kΩ/0.25 w	WF 125 k/0,25
R125	Resistor, depos. carbon	585 Ω ±1%/0.25 w	WF 585/1/0,25
R126	Resistor, depos. carbon	1 kΩ/0.5 w	WF 1 k/0,5
R129	Resistor, depos. carbon	125 kΩ/0.5 w	WFO 125 k/0,5
R130	Resistor, depos. carbon	100 kΩ/0.5 w	WFO 100 k/0,5

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Ref. No.	Designation	Ratings	R&S Stock No.
R131	Resistor, depos. carbon	3 kΩ/1 w	WFO 3 k/1
R132	Resistor, depos. carbon	50 kΩ/1 w	WFO 50 k/1
R133	Resistor, depos. carbon	1 kΩ/1 w	WFO 1 k/1
R134	Resistor, depos. carbon	160 Ω/0.25 w	WF 160/0,25
R135	Resistor, depos. carbon	200 kΩ/0.25 w	WF 200 k/0,25
R136	Resistor, depos. carbon	1 kΩ/0.25 w	WF 1 k/0,25
R137	Resistor, depos. carbon	50 kΩ/0.5 w	WF 50 k/0,5
R138	Resistor, depos. carbon	20 kΩ/1 w	WF 20 k/1
R139	Resistor, depos. carbon	100 kΩ/0.5 w	WF 100 k/0,5
R140	Resistor, depos. carbon	100 kΩ/0.25 w	WF 100 k/0,25
R143	Resistor, depos. carbon	500 Ω/0.5 w	WF 500/0,5
R144	Resistor, depos. carbon	500 Ω/0.5 w	WF 500/0,5
R145	Resistor, depos. carbon	500 Ω/0.5 w	WF 500/0,5
R146	Resistor, depos. carbon	500 Ω/0.5 w	WF 500/0,5
R147	Resistor, depos. carbon	20 kΩ/0.25 w	WF 20 k/0,25
R148	Resistor, depos. carbon	500 Ω/0.5 w	WF 500/0,5
R149	Resistor, depos. carbon	500 Ω/0.5 w	WF 500/0,5
R150	Resistor, depos. carbon	500 Ω/0.5 w	WF 500/0,5
R154	Resistor, depos. carbon	10 kΩ ±1%/0.5 w	WF 10 k/1/0,5
R155	Resistor, depos. carbon	10 kΩ ±1%/0.5 w	WF 10 k/1/0,5
R156	Resistor, depos. carbon, variable Resistor, depos. carbon	25 kΩ lin. 1 kΩ/0.5 w	WS 5122 F/25 k WF 1 k/0,5 in series
R157	Resistor, depos. carbon	1 kΩ/0.5 w 2 kΩ/0.5 w	WF 1 k/0,5 WF 2 k/0,5 parallel
R158	Resistor, depos. carbon	2 MΩ/0.25 w	WF 2 M/0,25
R159	Resistor, depos. carbon	400 kΩ/0.5 w	WF 400 k/0,5

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Ref. No.	Designation	Ratings	R&S Stock No.
R160	Resistor, depos. carbon	1.6 MΩ/0.5 w	WF 1,6 M/0,5
R161	Resistor, depos. carbon	100 kΩ/0.5 w	WF 100 k/0,5
R162	Resistor, depos. carbon	50 kΩ/0.5 w	WF 50 k/0,5
R163	Resistor, depos. carbon	800 kΩ/0.5 w	WF 800 k/0,5
R164	Resistor, depos. carbon	10 kΩ/0.25 w	WF 10 k/0,25
R165	Resistor, depos. carbon	2 kΩ/0.5 w	WF 2 k/0,5
R166	Resistor, depos. carbon	50 Ω/0.25 w	WF 50/0,25
R169	Resistor, depos. carbon	80 kΩ/0.5 w	WF 80 k/0,5
R171	Resistor, depos. carbon	16 kΩ/2 w	WF 16 k/2
R172	Resistor, depos. carbon, variable	10 kΩ lin.	WS 5122 F/10 k
R173	Resistor, depos. carbon	5 kΩ/0.5 w	WF 5 k/0,5
R174	Resistor, depos. carbon	2 kΩ/0.5 w	WF 2 k/0,5
R175	Resistor, wire-wound	30 kΩ/6 w	WDG 30 k/6
R176	Resistor, depos. carbon	3 kΩ/0.5 w	WF 3 k/0,5
R177	Resistor, depos. carbon	30 kΩ/0.5 w	WF 30 k/0,5
R178	Resistor, depos. carbon	100 kΩ/0.5 w	WF 100 k/0,5
R179	Resistor, depos. carbon	500 kΩ/0.5 w	WF 500 k/0,5
R180	Resistor, depos. carbon	1 MΩ/0.5 w	WF 1 M/0,5
R181	Resistor, depos. carbon	200 kΩ/0.5 w	WF 200 k/0,5
R182	Resistor, depos. carbon	50 Ω/0.25 w	WF 50/0,25
R183	Resistor, depos. carbon	10 kΩ/0.5 w	WF 10 k/0,5
R184	Resistor, depos. carbon	50 Ω/0.25 w	WF 50/0,25
R185	Resistor, wire-wound	2.5 kΩ/12 w	WD 2,5 k/12
R187	Resistor, wire-wound	4 kΩ/4 w	WD 4 k/4
R188	Resistor, depos. carbon, variable	10 kΩ lin.	WS 5122 F/10 k
R189	Resistor, depos. carbon, variable	10 kΩ lin.	WS 7126/10 k

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Ref. No.	Designation	Ratings	R&S Stock No.
R190	Resistor, depos. carbon	8 kΩ/0.5 w	WF 8 k/0,5
R191	Resistor, depos. carbon	2.5 kΩ/1 w	WFO 2,5 k/1
R192	Resistor, depos. carbon	2.5 kΩ/1 w	WFO 2,5 k/1
R193	Resistor, depos. carbon	1 kΩ/1 w	WFO 1 k/1
R194	Resistor, depos. carbon	1 kΩ/1 w	WFO 1 k/1
R195	Resistor, depos. carbon	2.5 kΩ/1 w	WFO 2,5 k/1
R196	Resistor, wire-wound	15 kΩ/4 w	WDG 15 k/4
R197	Resistor, depos. carbon	5 kΩ/2 w	WF 5 k/2
R198	Resistor, depos. carbon	5 kΩ/2 w	WF 5 k/2
R199	Resistor, wire-wound (with tap)	50 Ω/4 w	WV 4/50
R200	Resistor, depos. carbon	5 kΩ/0.5 w	WF 5 k/0,5
R201	Resistor, wire-wound (with tap)	100 Ω/4 w	WV 4/100
R202	Resistor, depos. carbon	50 kΩ/0.5 w	WF 50 k/0,5
R203	Resistor, depos. carbon	1 kΩ/1 w	WF 1 k/1
R204	Resistor, depos. carbon, variable Resistor, depos. carbon	500 Ω lin. 1 kΩ/0.5 w	WS 5122 F/500 WF 1 k/0,5 in series
R205	Resistor, depos. carbon	1 kΩ/1 w	WF 1 k/1
R206	Resistor, depos. carbon, variable	500 Ω lin.	WS 5122 F/500
R207	Resistor, depos. carbon, variable Resistor, depos. carbon	500 kΩ lin. 10 kΩ/0.5 w	WS 5122 F/500 k WF 10 k/0,5 in series
R210	Resistor, depos. carbon	406.5 Ω ±1%/0.25 w	WF 406,5/1/0,25
R211	Resistor, depos. carbon	133.3 Ω ±1%/0.25 w	WF 133,3/1/0,25
R212	Resistor, depos. carbon	133.3 Ω ±1%/0.25 w	WF 133,3/1/0,25
R213	Resistor, depos. carbon	406.5 Ω ±1%/0.25 w	WF 406,5/1/0,25
R215	Resistor, depos. carbon	1 kΩ/0.05 w	WF 1 k/0,05

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Ref. No.	Designation	Ratings	R&S Stock No.
R11	Lamp, incandescent	150 v/15 w	RL 303
R12	Lamp, projector	6 v/5 amps	RL 301
R13	Lamp, glow, miniature	220 v	RL 210
R14	Lamp, scale	6 v/0.5 amp	RL 165 S for I1
R15	Lamp, scale	6 v/0.5 amp	RL 165 S for I3
R81	Pentode		EF 80
R82	Pentode		EF 80
R83	Pentode		EF 80
R84	Pentode		EF 80
R85	Pentode		EF 80
R86	Pentode		EF 80
R87	Pentode		EF 800
R88	Pentode		EF 800
R89	Triode		EC 81
R810	Pentode		EF 80
R811	Pentode		EF 80
R812	Diode		EA 50
R813	Pentode		EF 80
R814	Pentode		EF 80
R815	Pentode		EF 80
R816	Pentode		EF 80
R817	Pentode		EF 80
R818	Pentode, output		EL 84
R819	Diode		EA 50
R820	Reference tube		85 A 2
R821	Pentode		EF 80

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Ref. No.	Designation	Ratings	R&S Stock No.
R822	Pentode, output		PL 81
R823	Pentode, output		PL 81
R824	Rectifier		EZ 80
R825	Rectifier		EZ 80
S1	Switch, coil		incl.in 3561 - 7
S2	Wafer		3561 - 7.46
S3	Push button		SR 62803
S4	Switch, wafer		SRN 324/2/32
S5	Fuse strip		FD 60517
S6	Connection link		incl.in 3561 - 3
Si1	Fuse	1.6 amps	1,6 D DIN 41571 (for 220 & 235 v)
		2.5 amps	2,5 D DIN 41571 (for 115 & 125 v)
Si2	Fuse	250 ma	0,25 C DIN 41571
Tr1	Transformer, bridge		3561 - 3.16
Tr2	Transformer, output		3561 - 3.17
Tr3	Transformer, power		3561 - 3.15/2
Tr4	Transformer, power		3561 - 3.18/2

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Guarantee

Rohde & Schwarz guarantee

F O R O N E Y E A R

each instrument manufactured and sold by them to be free from defects in material and workmanship, subject to clause 5 of their terms of delivery and payment.

This guarantee does not imply the right to rescind a sale or demand a reduction in purchase price. The firm's obligation under this guarantee is limited to the repair or replacement of the defective part or parts, provided the claim is asserted in writing immediately, or within one week at the latest, after discovery of the defect. The part or parts shall be returned to the factory, with transportation charges prepaid, within one week from the instruction by the firm to do so. The return charges shall likewise be covered by the purchaser. The firm does not assume any liability for damage resulting directly or indirectly from the defect. The guarantee shall be void if the part or parts have been tampered with.

The seals of the instrument shall be undamaged. Rohde & Schwarz guarantee valves for which the purchaser has not received the certificate of guarantee of the manufacturer. Defective valves which are held to be covered by this guarantee shall be returned to the factory for examination. The following details shall be specified:

Number, date and reference of the invoice;

type and serial number (FNr.) of the instrument;

specification of valve defect.

R O H D E & S C H W A R Z · M Ü N C H E N

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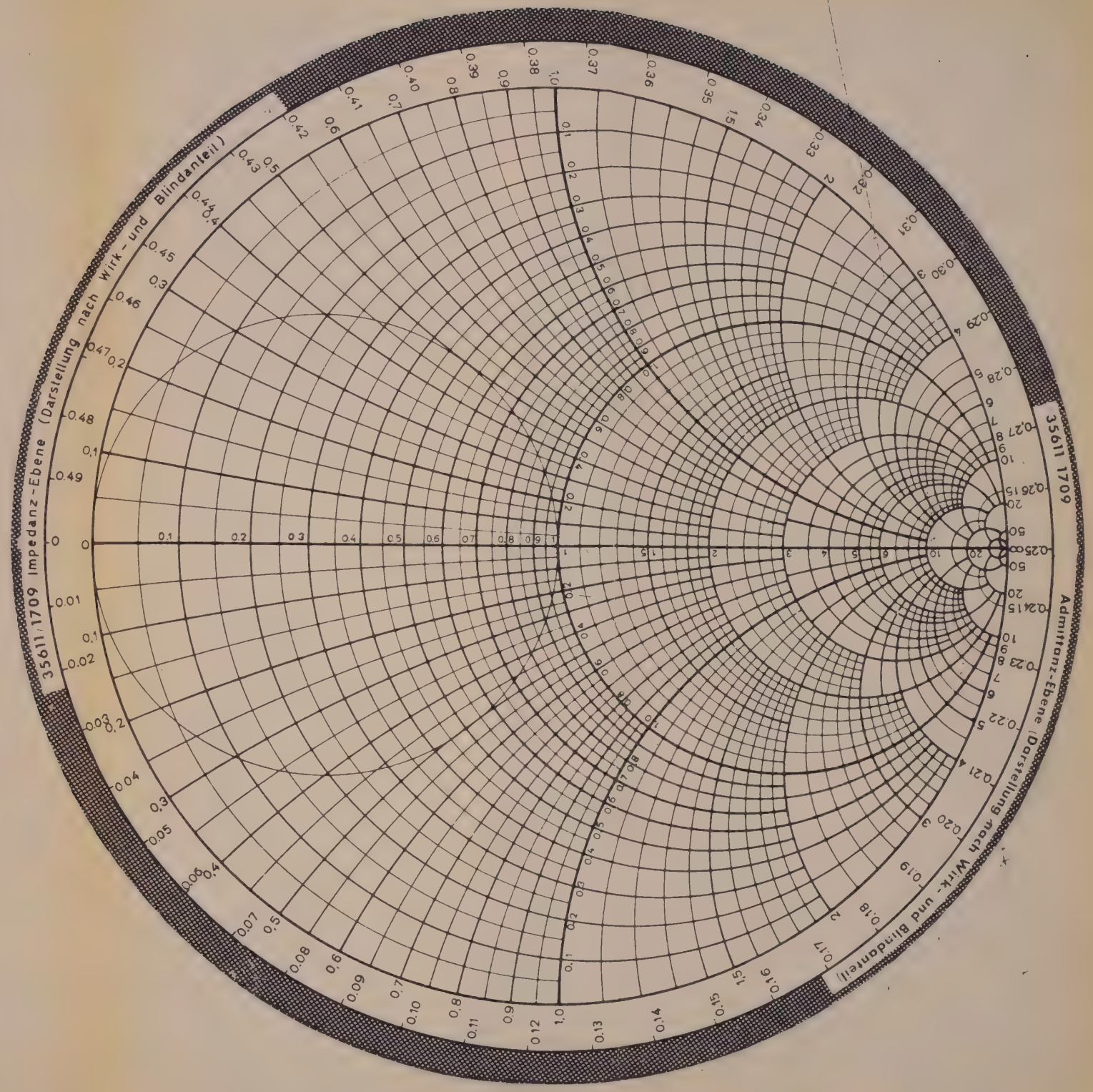

35611 1709
Impedanz-Ebene (Darstellung nach Wirk- und Blindanteil)
35611-1709 Impedanz-Ebene
Admittanz-Ebene (Darstellung nach Wirk- und Blindanteil)

Fig. 1

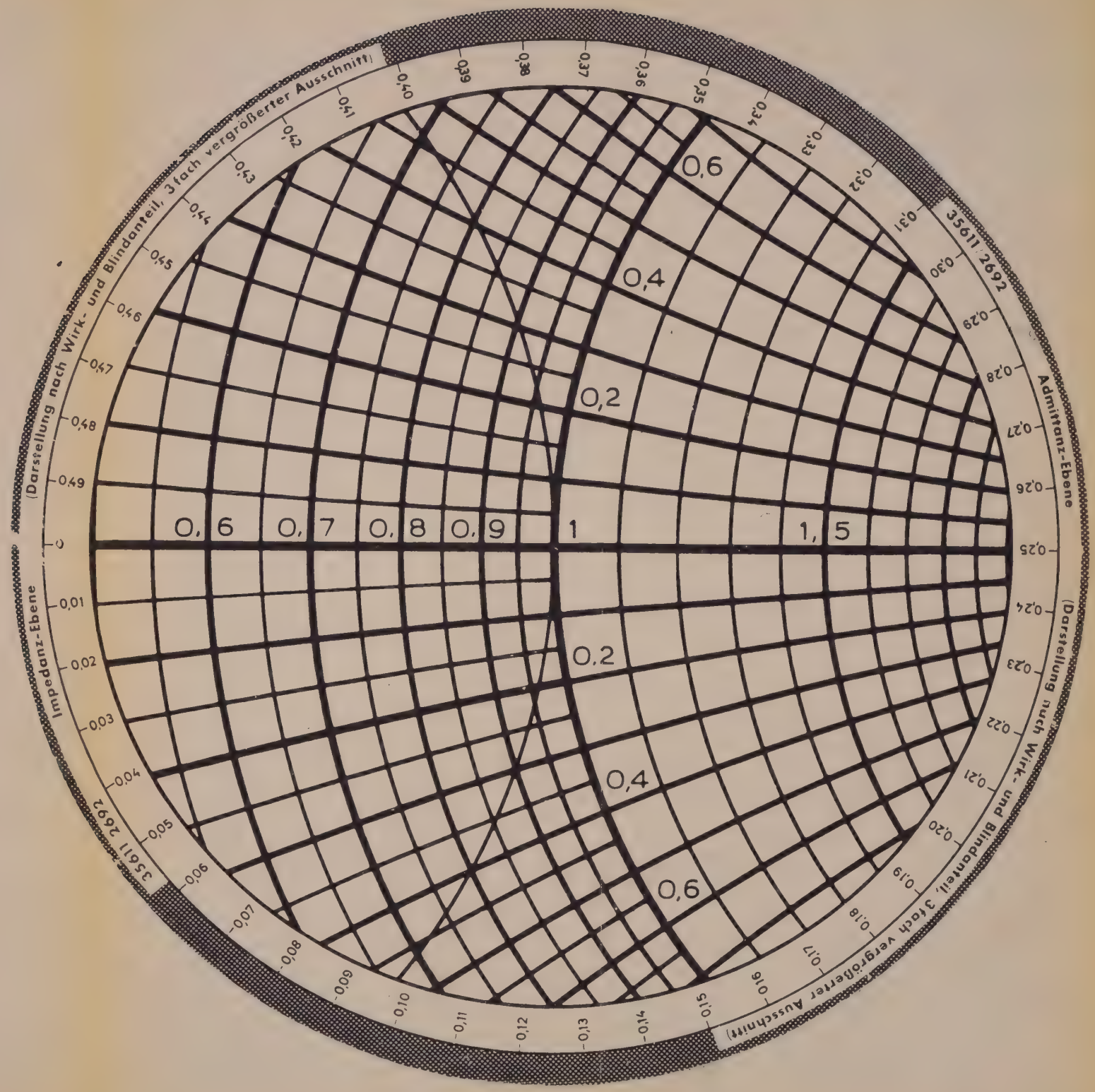

(Darstellung nach Wirk- und Blindanteil, 3fach vergrößerter Ausschnitt)
Admittanz-Ebene
35611 2692
(Darstellung nach Wirk- und Blindanteil, 3fach vergrößerter Ausschnitt)
Impedanz-Ebene
35611 2692
0,6
0,4
0,2
0,2
0,4
0,6
0,6
0,7
0,8
0,9
1
1,5

Fig. 2

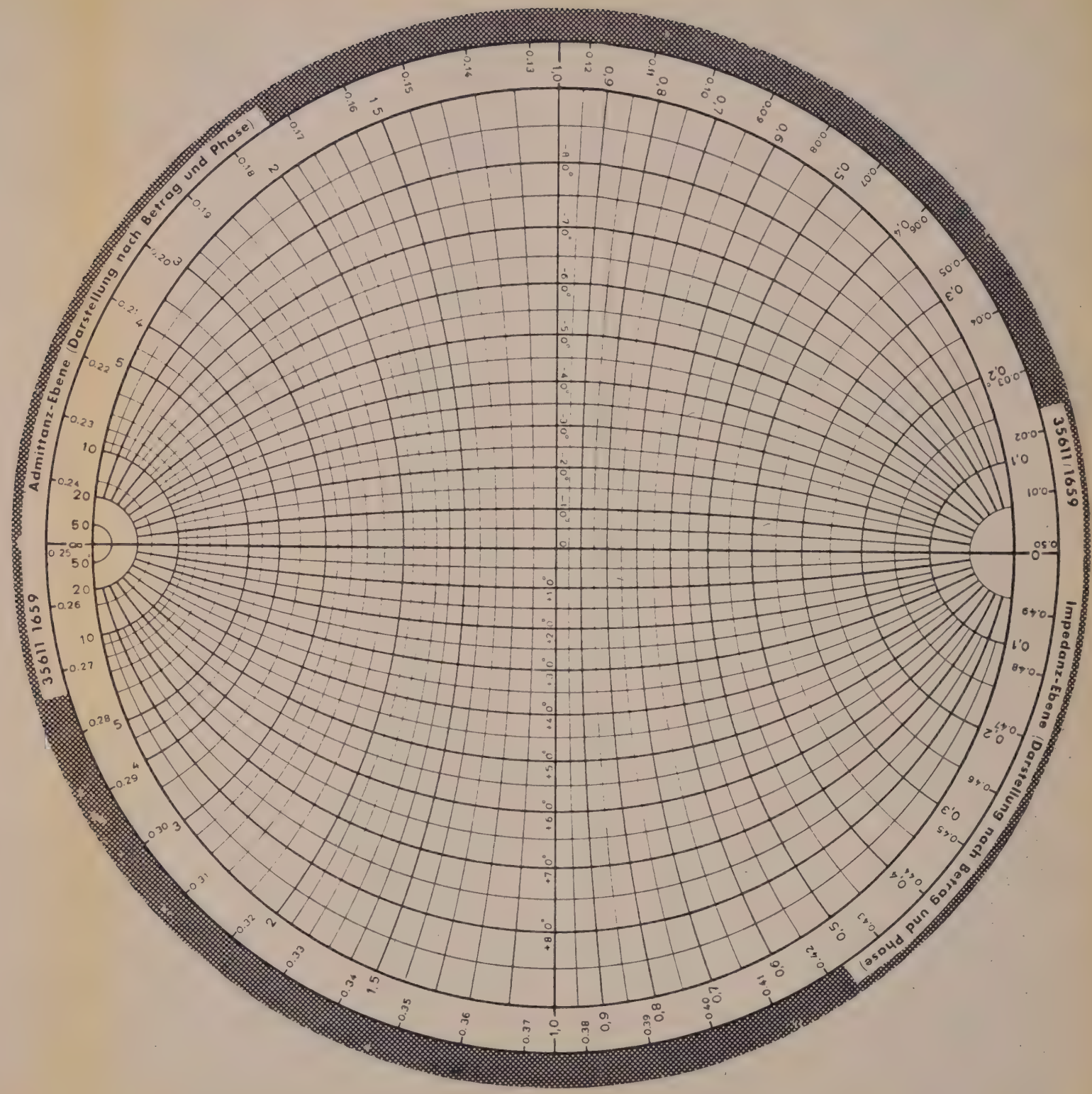

Admittanz-Ebene (Darstellung nach Betrag und Phase)
35611 1659
Impedanz-Ebene (Darstellung nach Betrag und Phase)
35611 1659

Fig. 3

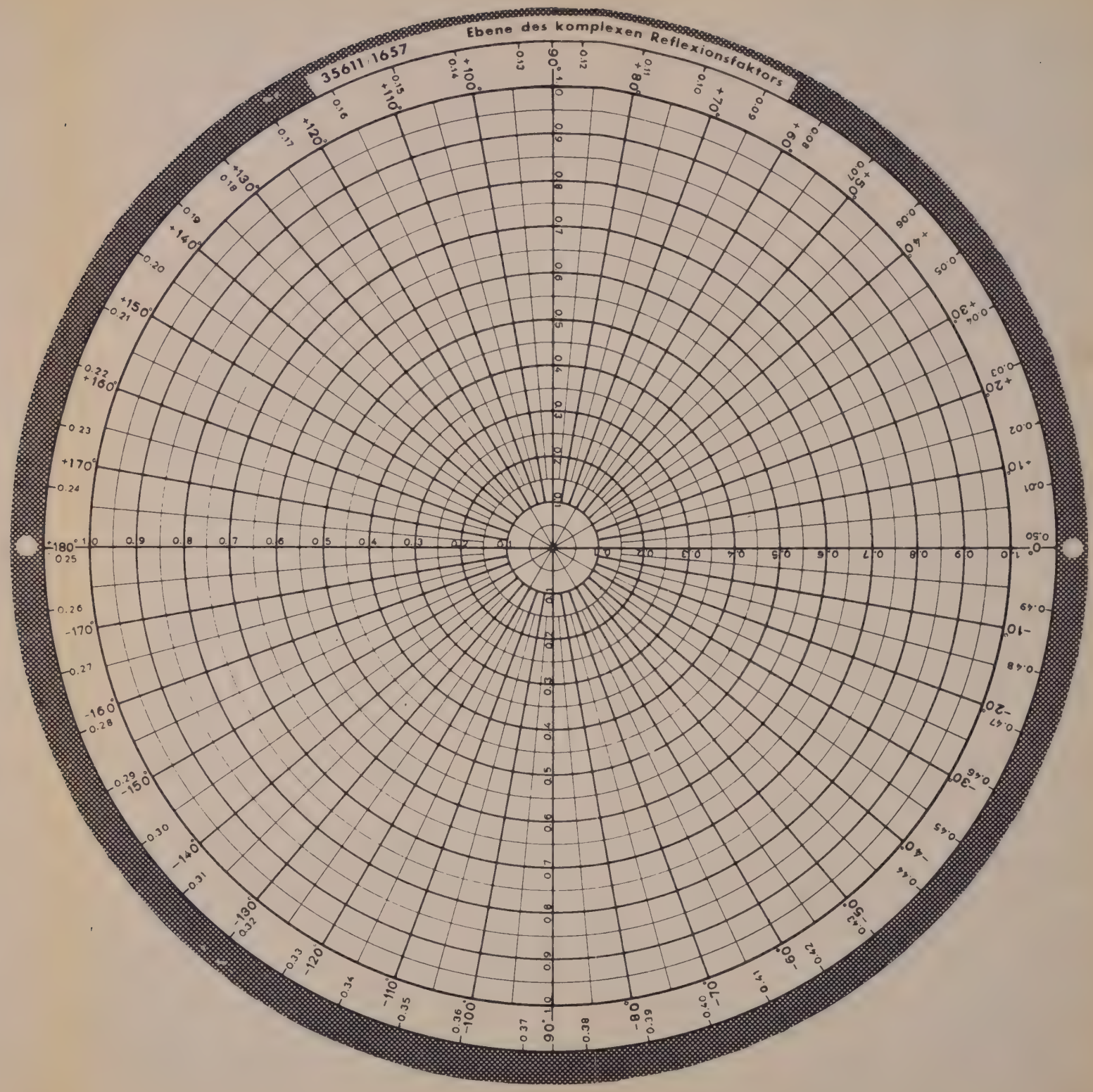


Fig. 4

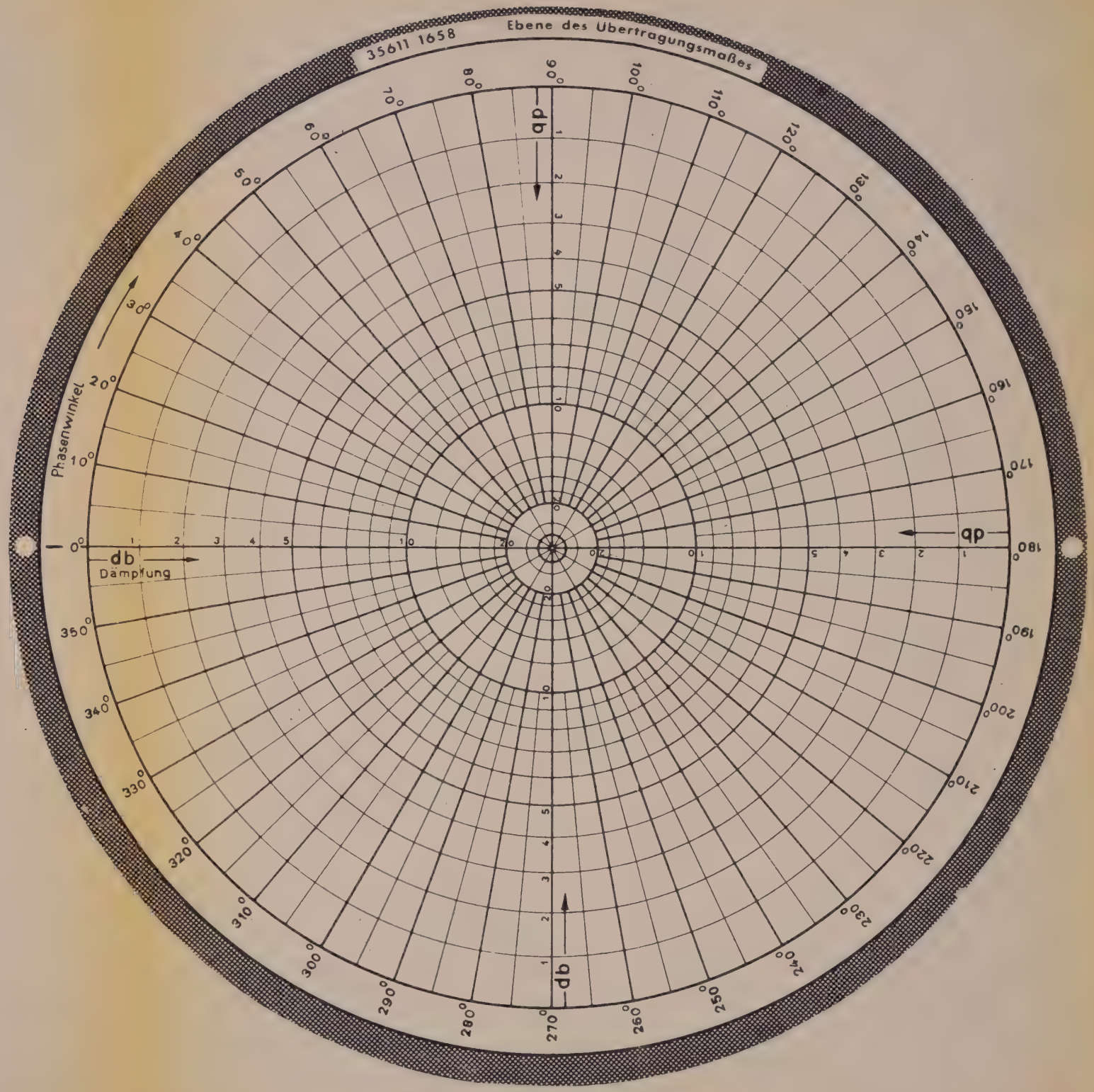
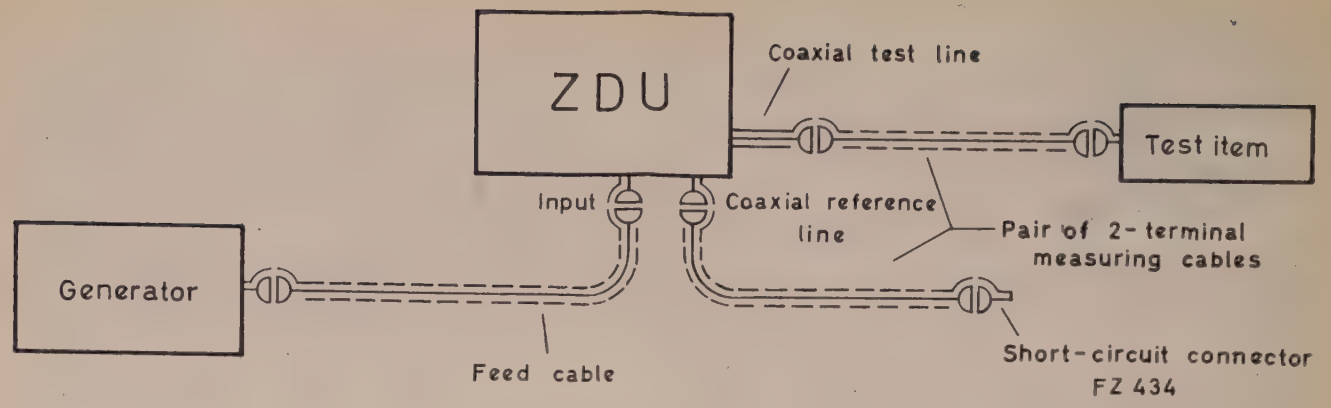
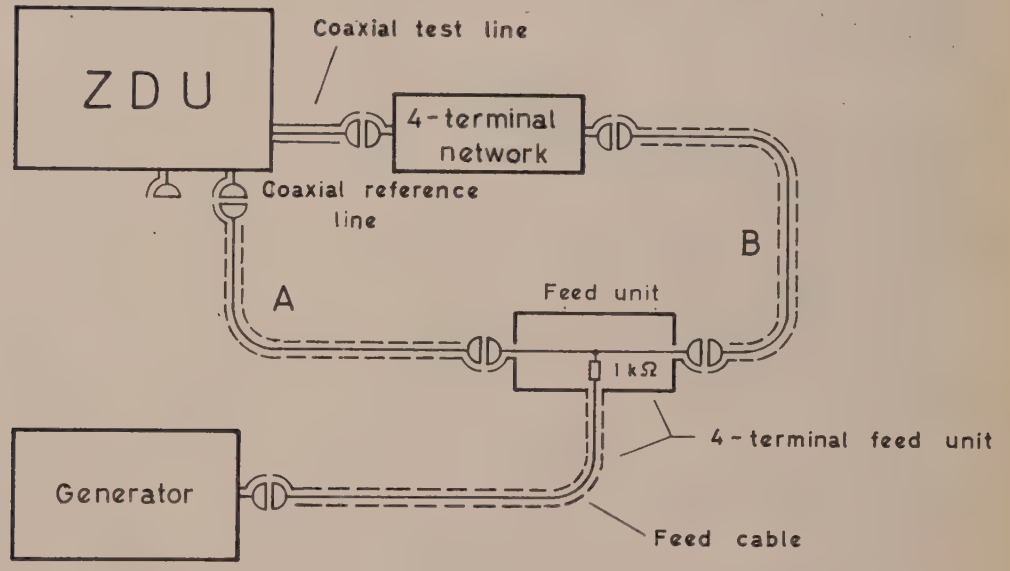

35611 1658
Ebene des Übertragungsmaßes
Phasenwinkel
db
Dämpfung
qp
db
qp
db

Fig. 5



Setup for impedance measurements on hard-to-get-at items

Fig. 6



Setup for 4-terminal network measurement, using the 4-terminal feed unit consisting of feed unit and feed cable; A and B represent the pair of 2-terminal measuring cables

Fig. 7

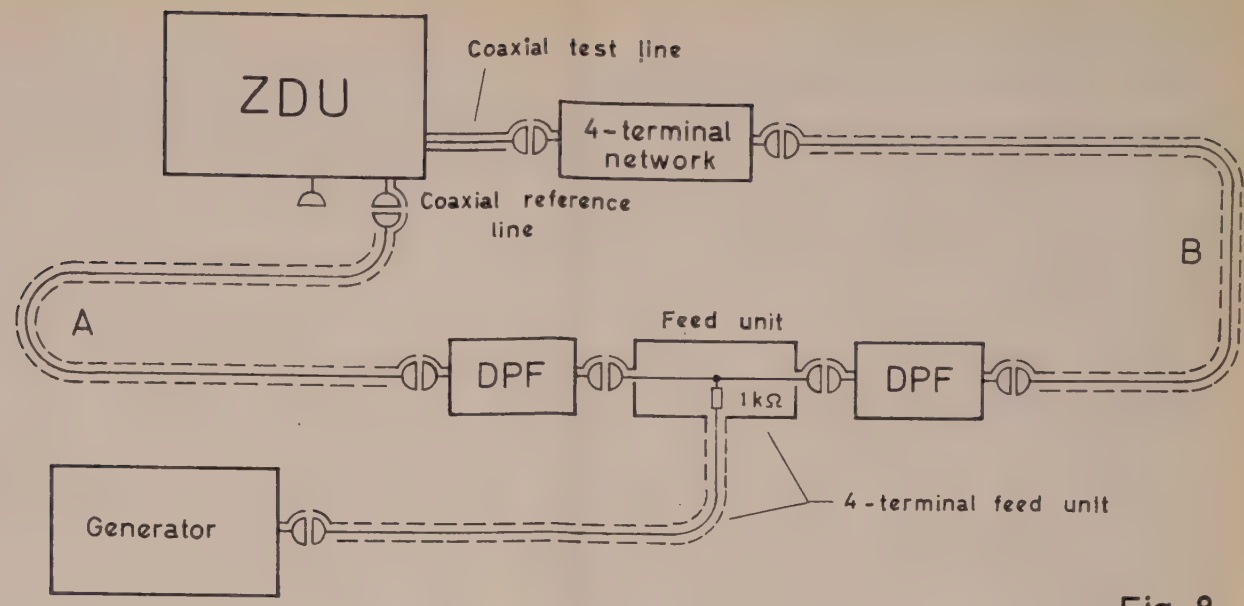


Fig. 8

Setup for precision 4-terminal network measurement using two UHF Attenuators Type DPF and the 4-terminal feed unit, with the Z of the 4-terminal network well matched to the Z of the cable

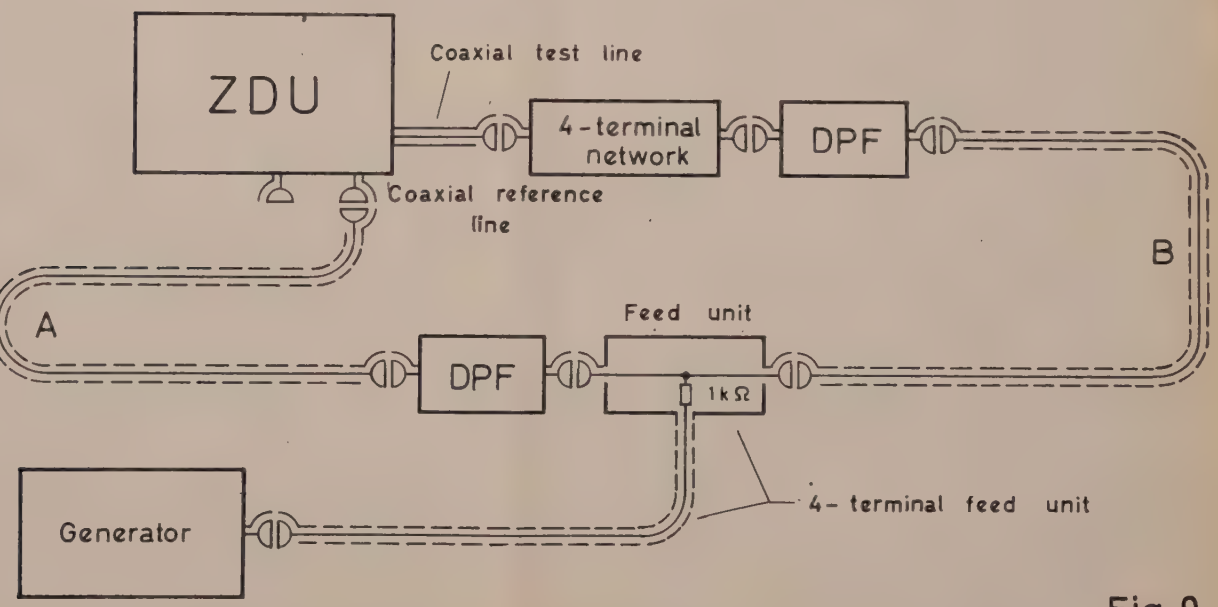
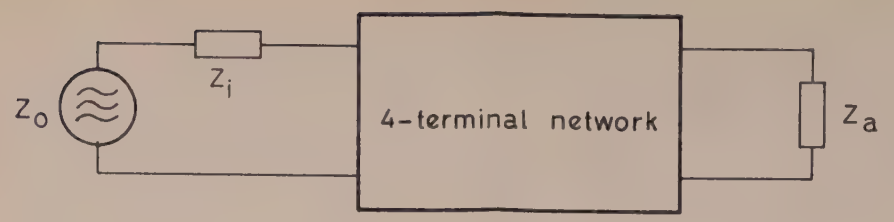


Fig. 9

Setup for precision 4-terminal network measurement using two UHF Attenuators Type DPF with the Z of the 4-terminal network poorly matched to the Z of the cable



Basic circuit arrangement for determination of the transfer constant

Fig. 10

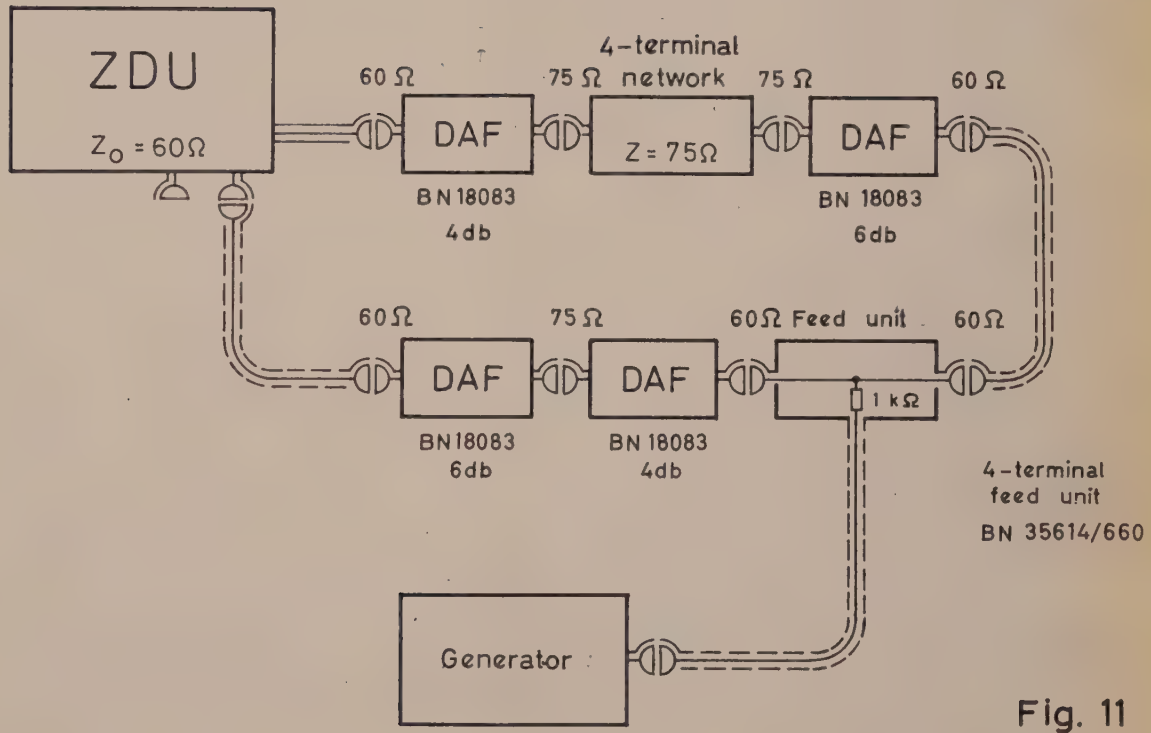


Fig. 11

Setup for measurement of the transfer constant with
$Z_s \gtrless Z_l \gtrless Z_o$ using Matching Pads Type DAF
A and B represent the pair of 2-terminal measuring
cables of $Z_o = 60\,\Omega$

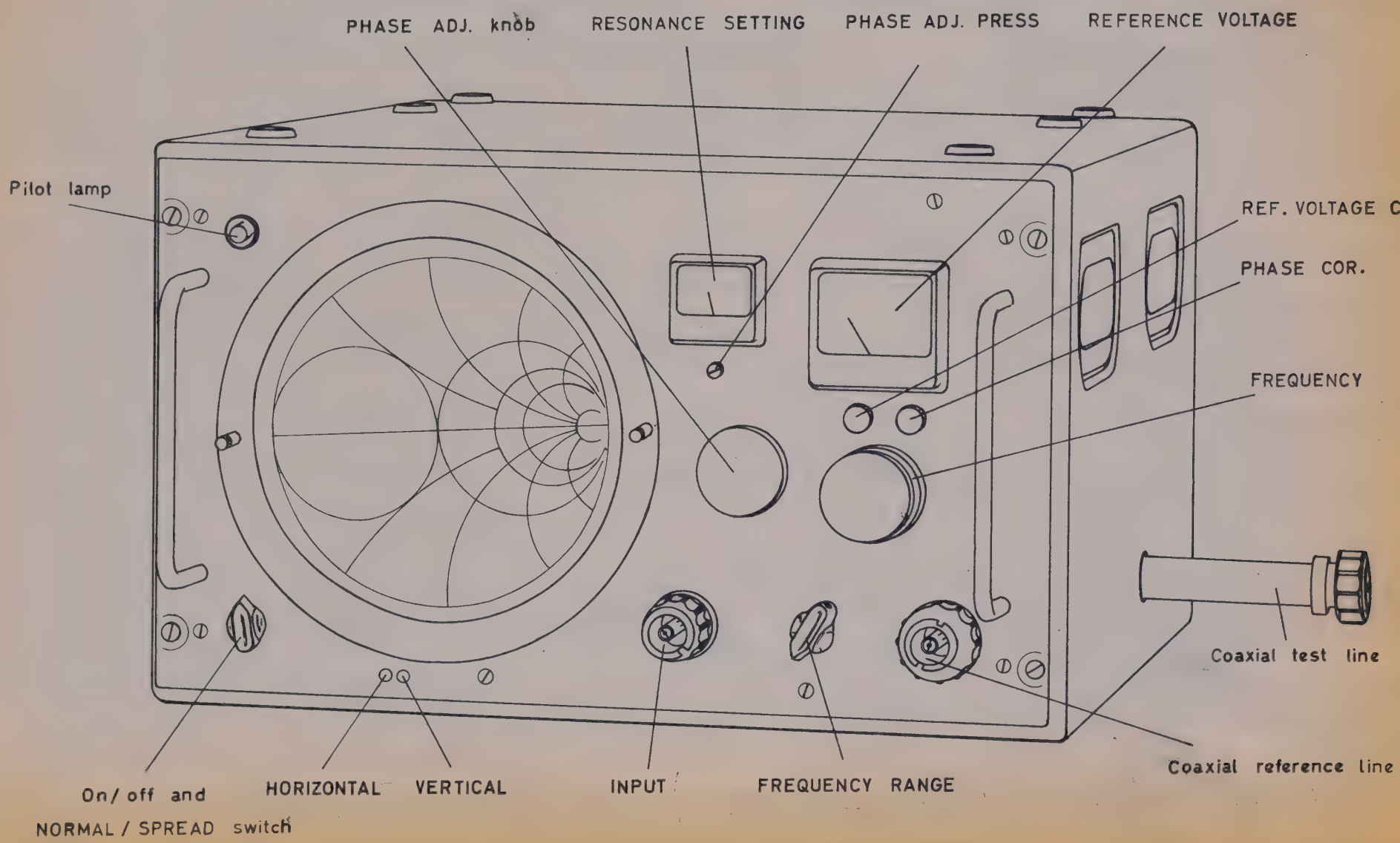

PHASE ADJ. knob
RESONANCE SETTING
PHASE ADJ. PRESS
REFERENCE VOLTAGE
Pilot lamp
REF. VOLTAGE COR.
PHASE COR.
FREQUENCY
Coaxial test line
Coaxial reference line
On/ off and
NORMAL / SPREAD switch
HORIZONTAL
VERTICAL
INPUT
FREQUENCY RANGE

Fig. 12

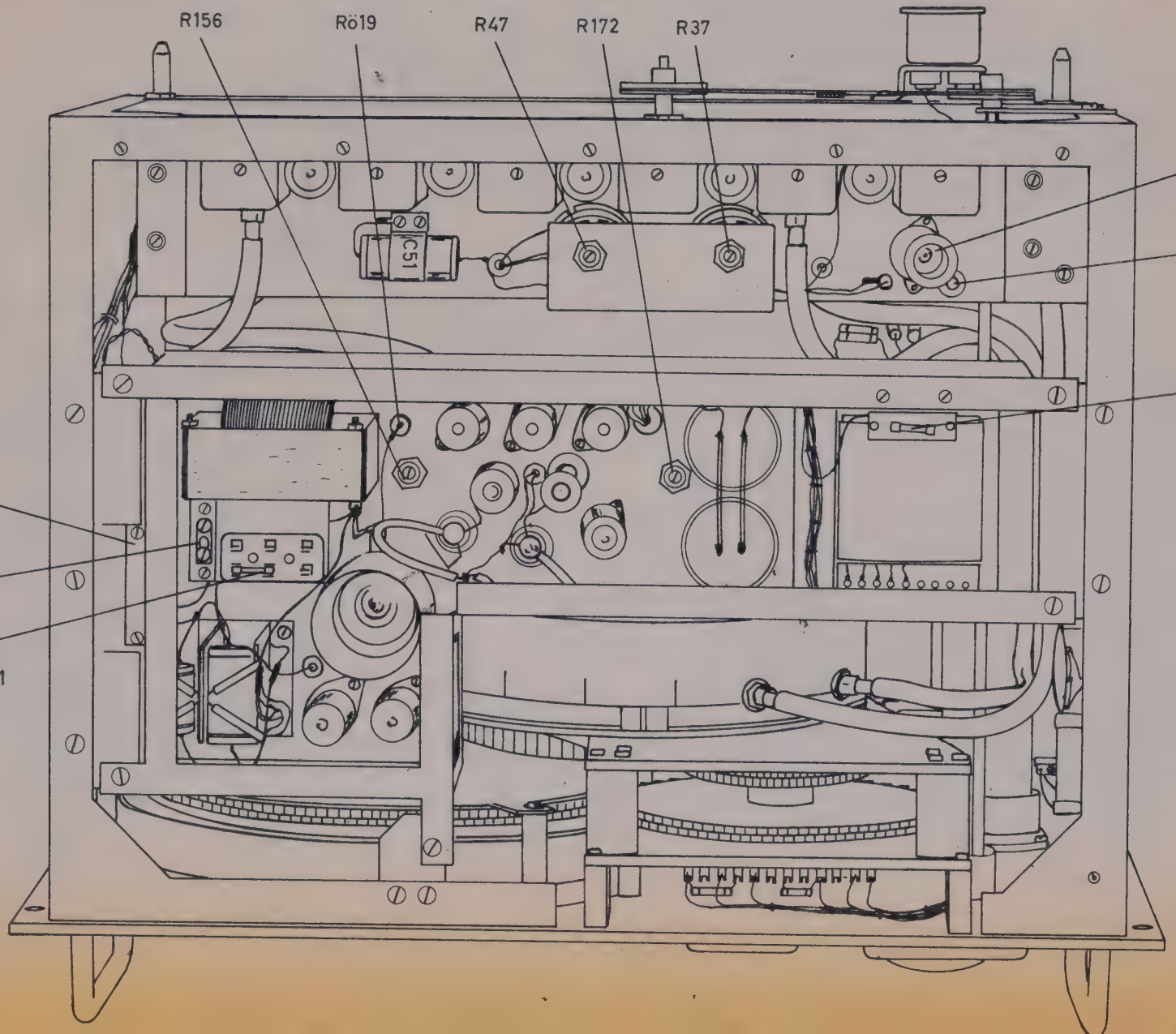

R156
Rö19
R47
R172
R37
Rö6
Test point 15
Anode fuse Si 2
Multi – point connector
AC supply frequency selector
AC supply tapping panel and fuse Si 1
C51

Fig. 13

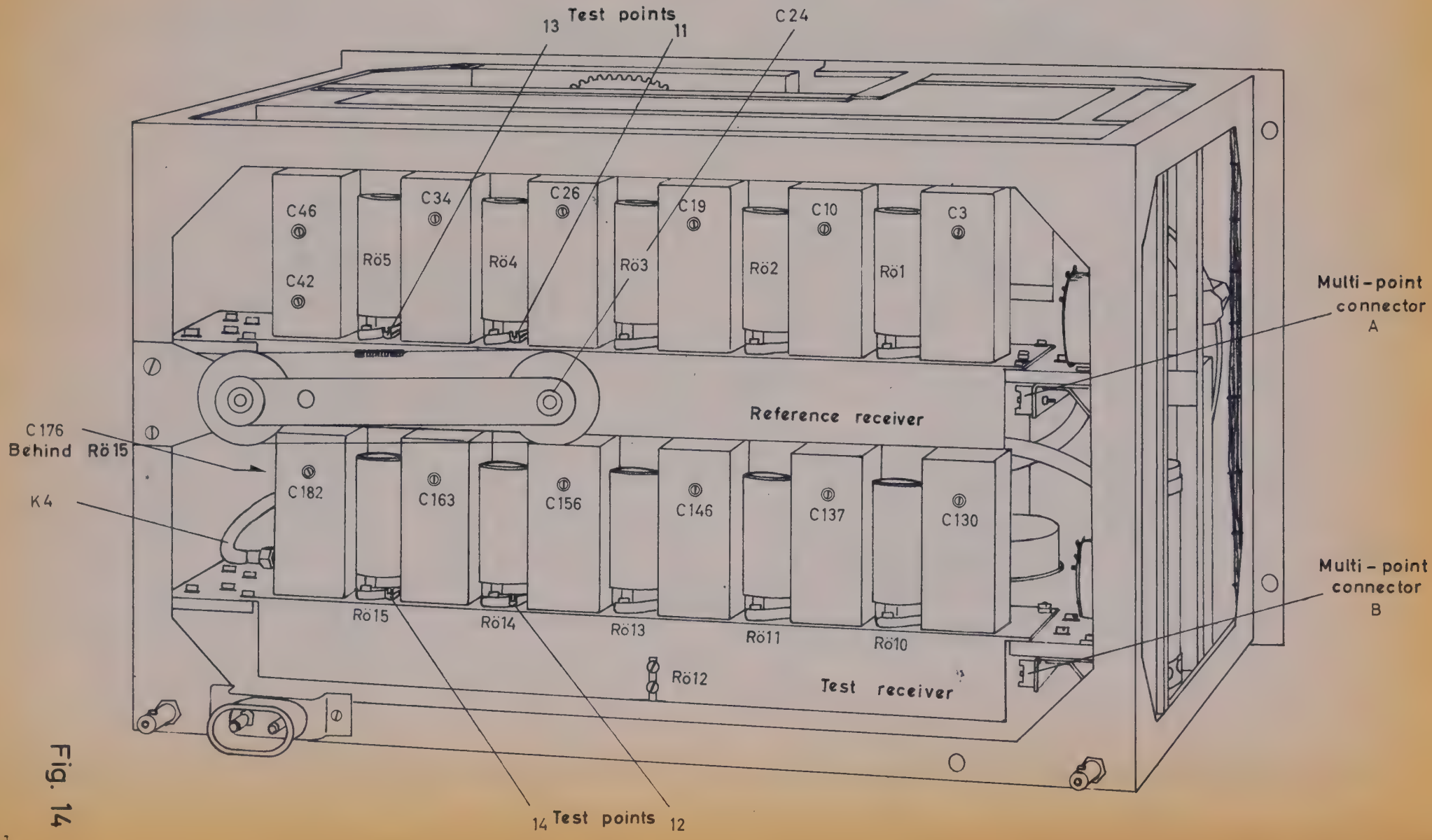

Test points
13
11
C24
C46
C42
C34
C26
C19
C10
C3
Rö5
Rö4
Rö3
Rö2
Rö1
Multi-point connector A
Reference receiver
C176 Behind Rö15
K4
C182
C163
C156
C146
C137
C130
Rö15
Rö14
Rö13
Rö11
Rö10
Rö12
Test receiver
Multi-point connector B
14 Test points 12

Fig. 14

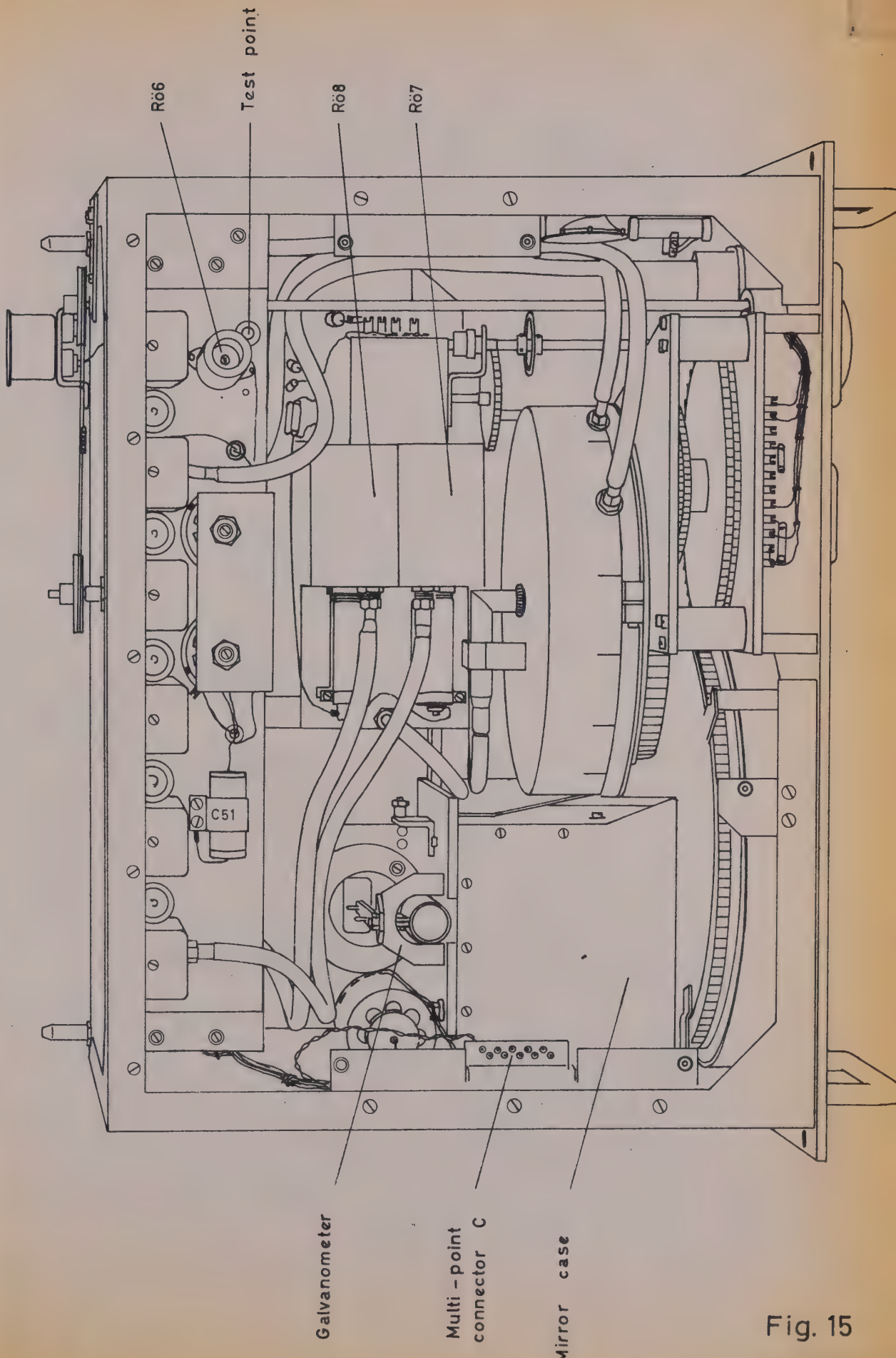

Rö6
Test point
Rö8
Rö7
C51
Galvanometer
Multi-point connector C
Mirror case

Fig. 15

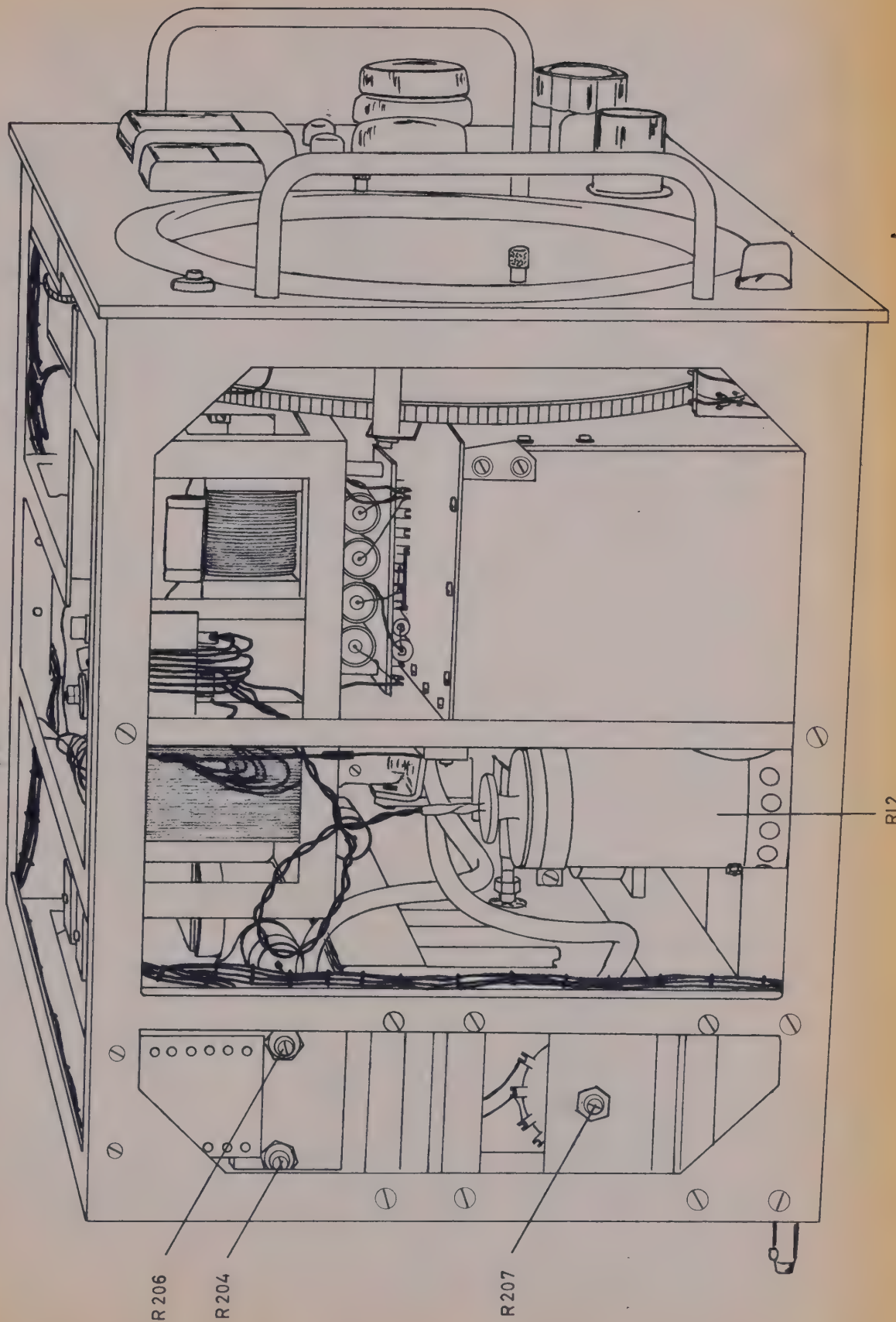


Fig. 16

R 7608
162
Bl. 78

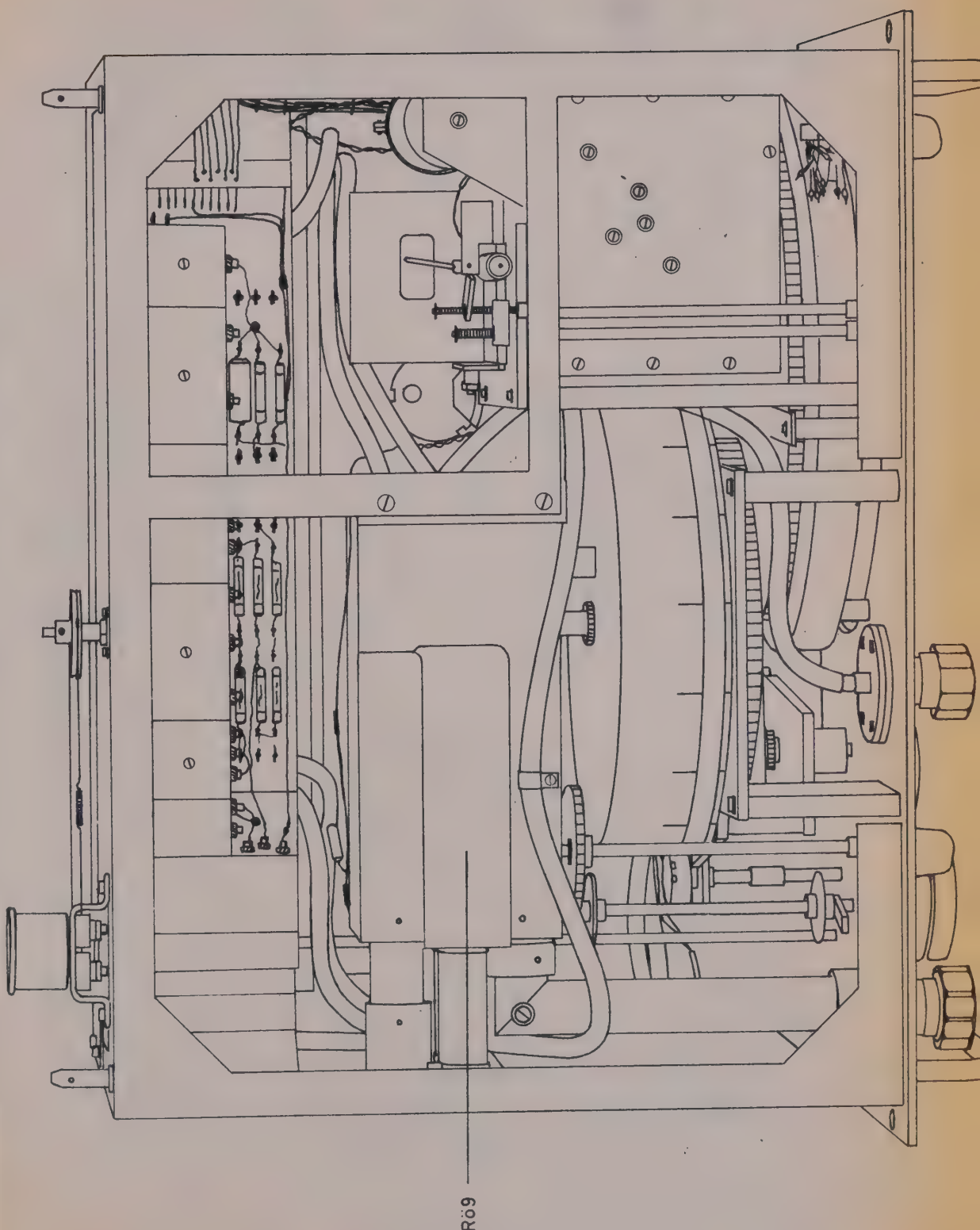


Fig. 17

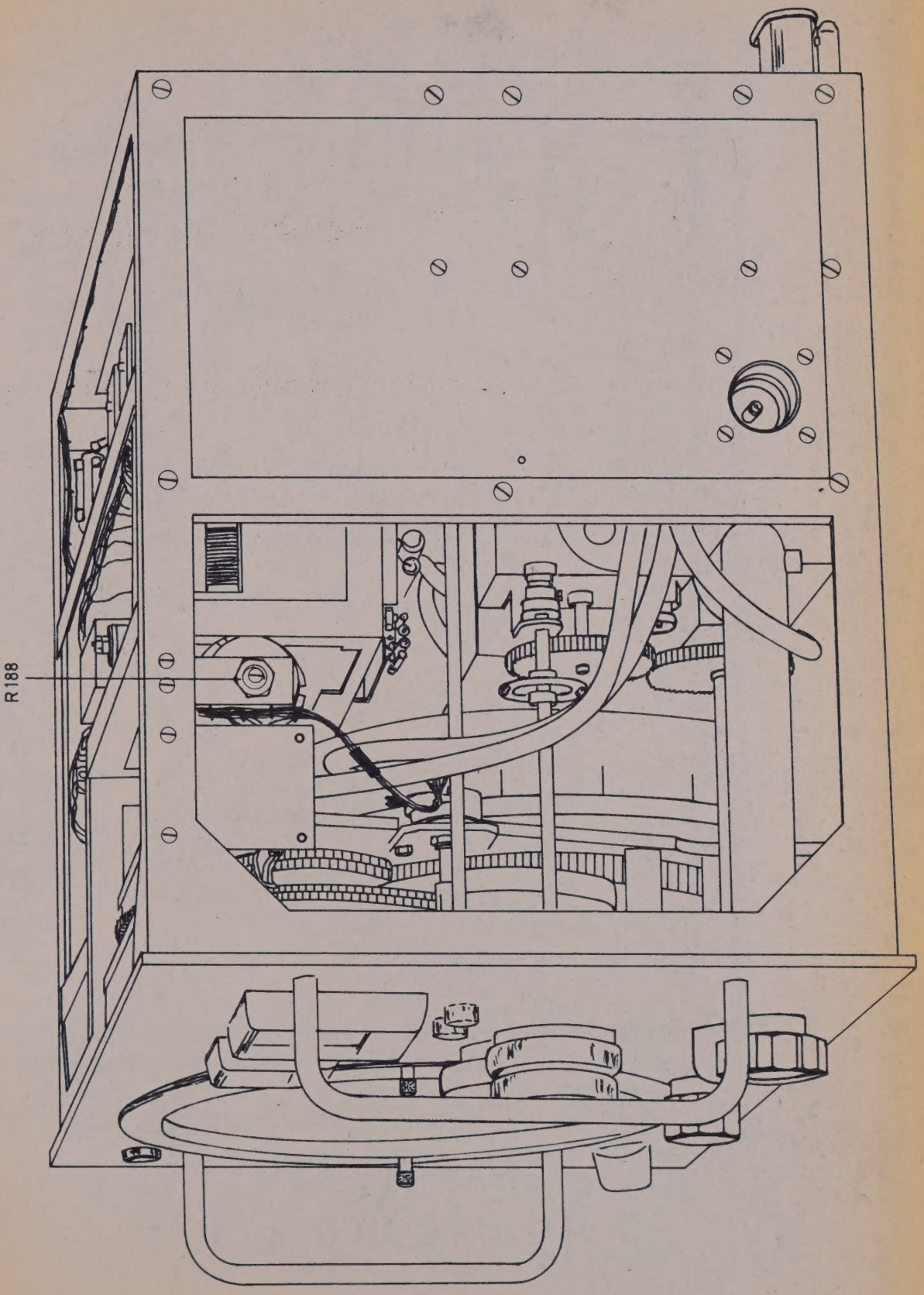
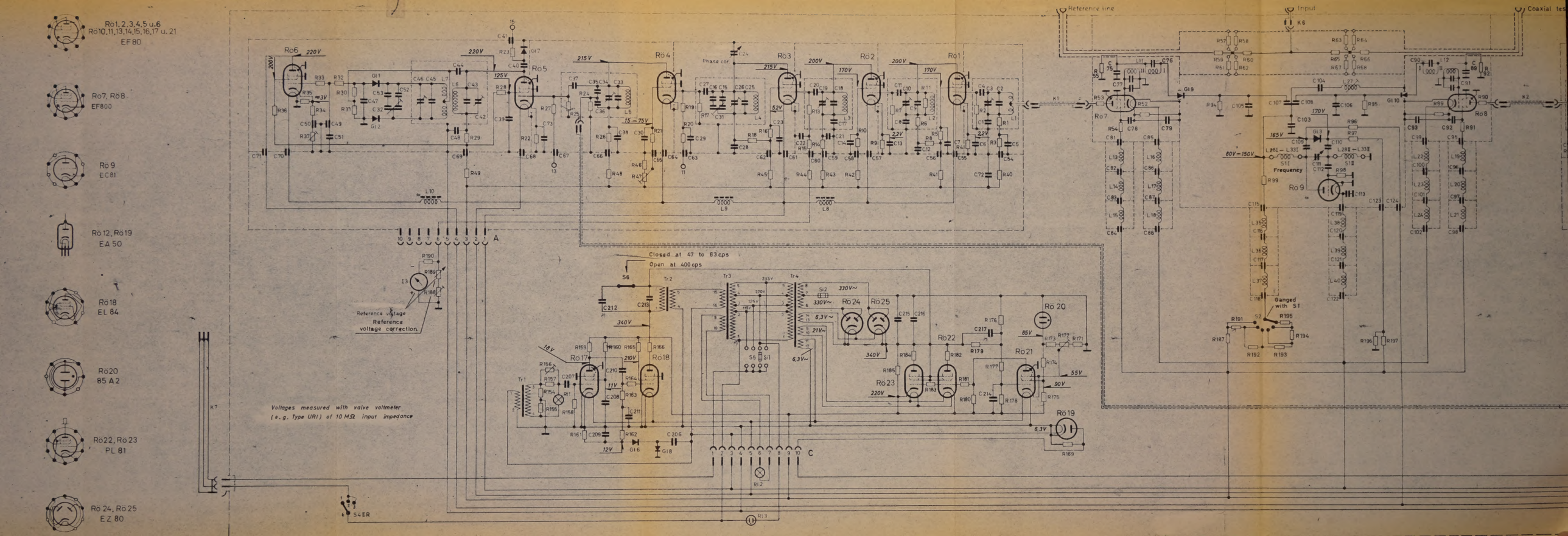
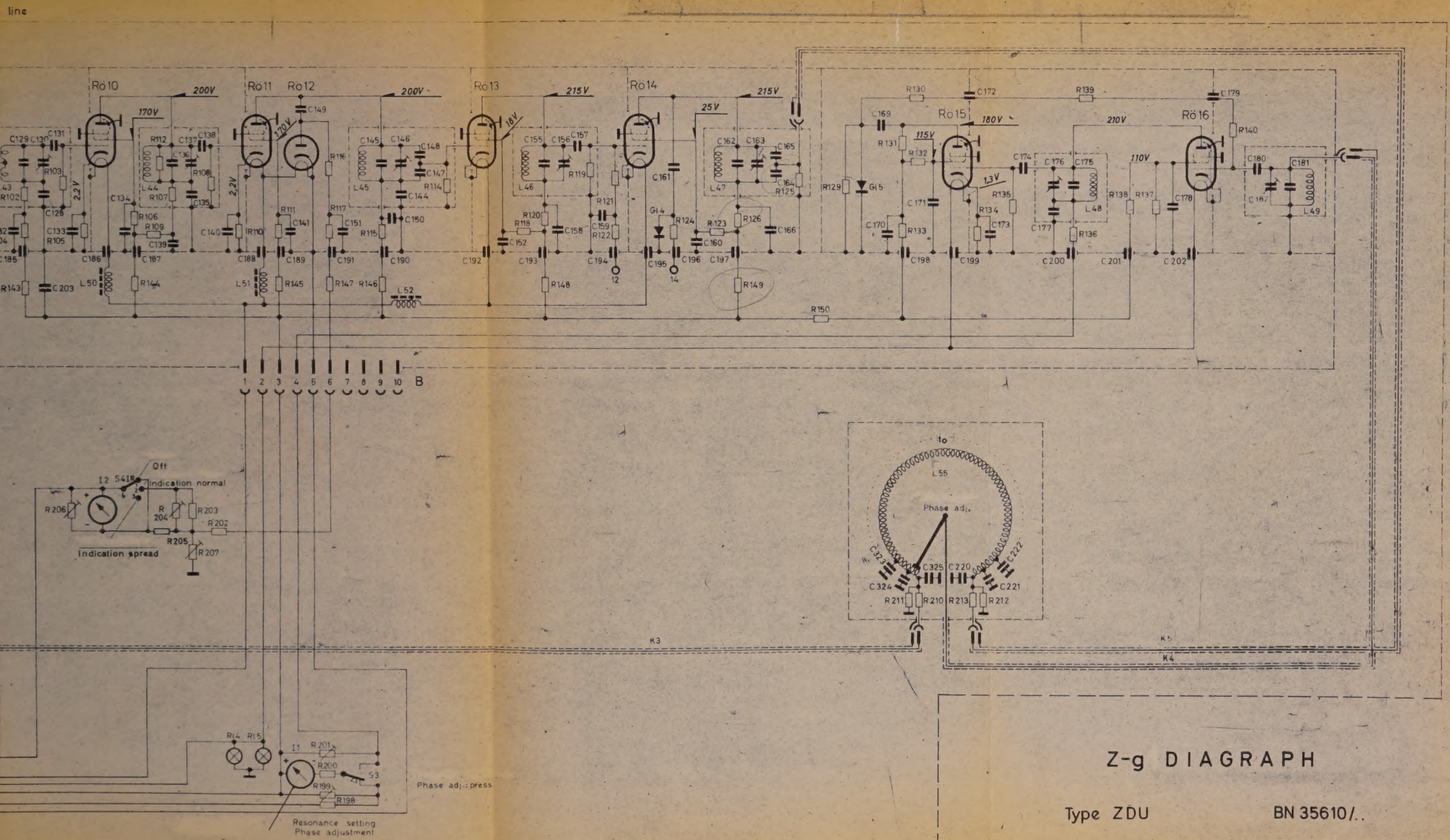


Fig. 18


Rö1, 2, 3, 4, 5 u. 6
Rö10, 11, 13, 14, 15, 16, 17 u. 21
EF 80
Rö7, Rö8
EF 800
Rö 9
EC 81
Rö 12, Rö 19
EA 50
Rö 18
EL 84
Rö 20
85 A 2
Rö 22, Rö 23
PL 81
Rö 24, Rö 25
EZ 80
Reference line
Input
Coaxial te
Closed at 47 to 63 cps
Open at 400 cps
Reference voltage
Reference voltage correction
Frequency
Ganged with S1
Voltages measured with valve voltmeter (e.g. Type URI) of 10 MΩ input impedance

line



Z-g DIAGRAPH

Type ZDU

BN 35610/..